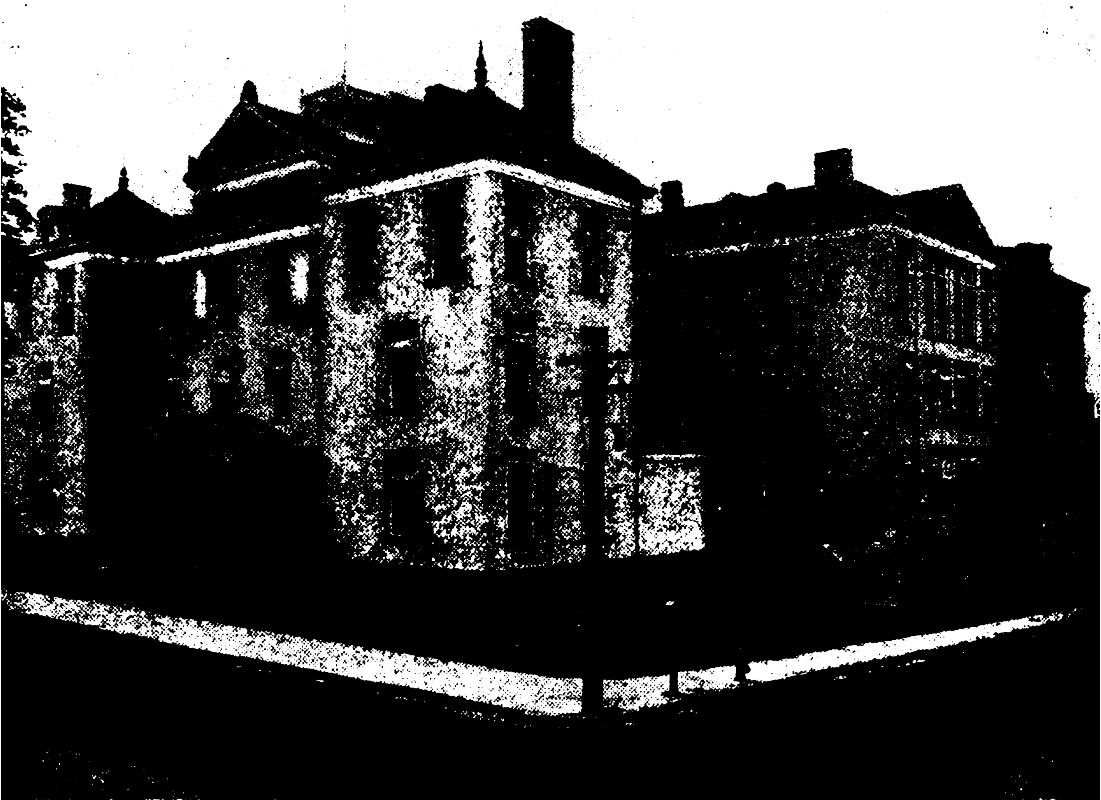

The Locomotive

Hartford Steam Boiler
Inspection and Insurance Company

The Locomotive

OF

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

VOL. XXIX.

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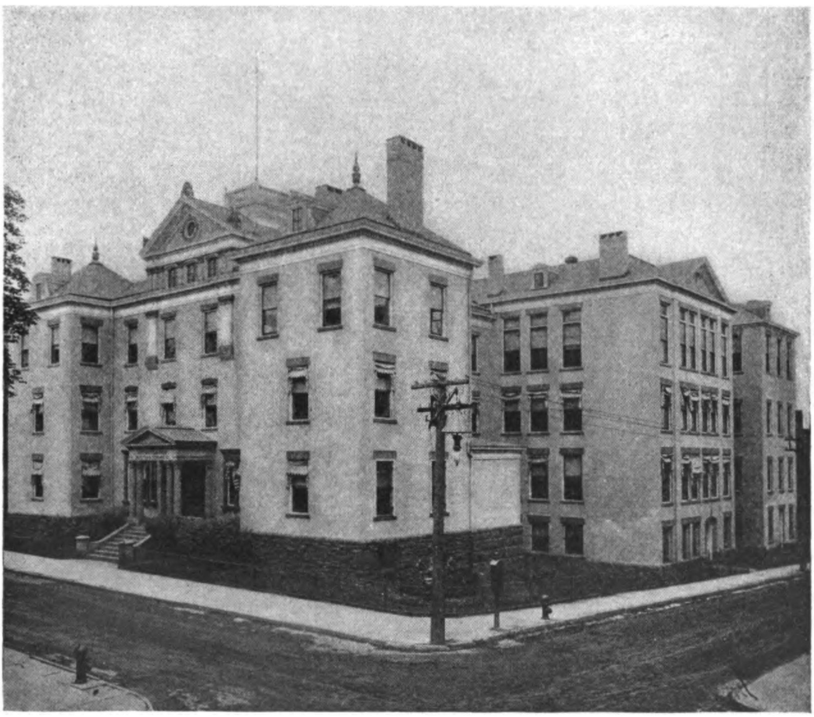


HOME OFFICE BUILDING

Prospect and Grove Streets, Hartford, Conn.

Water Gage Glasses.

CHARLES S. BLAKE.

The breaking of water gage glasses is of such frequent occurrence, that a few words concerning their attachment and use may, if heeded, prevent some accident and possibly personal injuries, besides the annoyance of frequent replacements.

The use of a visible gage as an auxiliary to indicate height of water in a steam generator has become a recognized necessity, and is required by authorities exercising jurisdiction over boilers. One municipality at least places such value on their use as to recognize a second gage glass as a substitute for the gage cocks and does not require the latter when two gage glasses are properly affixed.

The ordinary or customary gage glass is a plain cylindrical tube, ranging for ordinary use from ⅝ inches to ⅞ inches in diameter and of a length to suit the varying conditions and types of boilers. These diameters are outside dimensions. They vary slightly, but as the glasses are set in compressible washers such variation is not detrimental. They are made in this country and abroad, but those of Scotch glass are considered the best. The very nature of the material makes it brittle, and aside from its brittleness it possesses other peculiar qualities that when known should cause engineers and firemen to handle these glasses with more than ordinary care. A novice in examining a gage glass will almost immediately pronounce it defective, because of the fine lines running lengthwise in it; but such lines are usually indicative of good quality and are more pronounced in the Scotch glass than in the American.

All glasses are keenly susceptible to surface abrasions, even so minute as to be unobservable. If one receives the slightest scratch inside or out, it should not be used, and in handling or keeping them in stock, no metal of any nature should be allowed to come in contact with them. They are particularly liable to break if iron or steel touches them, and so should never be laid down even temporarily with tools, as is frequently done in preparation for a renewal.

It may sometimes be thought desirable to clean an old glass when it has every appearance of being whole and sound. In such an event waste or a cleaning cloth should be used and should be pushed through the bore by means of a wooden stick small enough to pass without force. As a rule, however, the price of gage glasses is too low to bother with the cleaning of old ones, and if one shows any deterioration at its ends, it should be discarded in any case.

In the prevention of accidents, not the least measure of importance is to have the receptacles for the glass properly attached before trying to insert it. Every one who has had occasion to put in gage glasses is familiar with the so-called gage glass "cocks," which form its support. They are not cocks, however, but valves. In some of the special types of water glass connections, cocks are used as a means of closing, but the percentage in use is very small. The valves are fitted in various ways,— sometimes directly into the boiler plate, more commonly into water columns of cast iron or those improvised from ordinary pipe and fittings. The openings to receive the valves should be parallel and threaded an equal depth, so that when the valves themselves are screwed in position the sockets in them for the reception of the glass will be in a direct line. Both top and bottom valves have these sockets bored out to a considerable depth. If the eye cannot detect the valves out of line, the glass

should be inserted in them, to more clearly determine whether the valves are in true alignment or not. The glass should be cut to the greatest length that will permit its insertion, one cock or valve usually admitting it to a greater depth than the other.

In the selection of a glass, one should be used that will freely enter the valve receptacle and leave a little space around it when in position, and the nuts or glands for compressing the gaskets should be large enough not to touch the glass when screwed up. Only fresh, pure rubber gaskets or washers cut by machine, uniform in size, and prepared for such purpose should be used. After inserting the glass in the valves, it should be shifted so the washers will be at an equal distance from its ends. This is very important, for the writer in his investigations of boiler explosions has found two instances where a washer softened by the heat, under pressure of the gland, has squeezed out under the glass and closed the opening, thus permitting a false indication of the water level. The glands should first be screwed by hand, each a little in turn until they can no longer be moved by the fingers. Then a small wrench may be used on them alternately, until the glass is firm in the packing. Care should be taken that the glass does not shift in its vertical position, during this operation.

It may be needless to say that in renewing a glass with pressure on the boiler, the valves should be closed tight and the drip opened to release the pressure before attempting the removal. When a new glass has been put in, if the valves are not provided with means for opening at a distance, a board or sheet-iron shield large enough to protect one's head should be held between the face and the glass, and the valves then opened very easily and slowly to their full extent. When they are open, it is advisable to retire with the shield in front of the face to observe at a distance whether there are any leaks, and if any appear, to return to the glass with the face still protected, shut off the valves, release the pressure through the drip, and then tighten the nuts. Never under any circumstances attempt to tighten them with pressure on the glass.

In the writer's experience, he has found it possible to make the joints tight by only a slight pressure of the wrench and whenever he has found gage valves out of alignment he has trued them up. As a result of this practice during considerable experience with marine and stationary boilers never has he had a glass break under pressure.

If gage glasses are properly handled and used they will withstand great extremes of temperature, although it is well to guard against drafts from outside in cold weather. In the selection of glasses it is not necessary to pick out the ones with the heaviest walls, for those with slightly lighter walls are as strong and will last as long as the thicker ones.

The great precaution is to keep the surface from being scratched, for, as every engineer knows it requires but the slightest breaking of the skin of the glass in a circumferential way to cause it to almost fall apart. The peculiar phenomenon of the glass breaking which has lain next to iron or steel has never been explained to me, but I have a number of times as an experiment, taken a glass, run a smooth rod of iron through it and put it away. Sooner or later it has been found shattered in many pieces. My first observation of this phenomenon was when I placed a glass on a shelf in an engine room with a large pocket knife against it to keep it from rolling off. The next day I found the glass all in pieces but the pieces in their respective positions, showing that the breakage was not from violence else the pieces would have been scattered.

A Scotch Marine Boiler Explosion.

Because of the small number of Scotch marine boilers in the United States, it is comparatively rare that an explosion of one is recorded, and owing to this fact a layman often has the impression that this type is proof against explosion. That this is not the case, however, is shown by the following account of an accident to such a boiler which occurred at the plant of The Mt. Clemens Sugar Company, Mt. Clemens, Mich., on October 30, 1911. The photograph, Figure 1, gives some idea of the condition of the front of the boiler after the explosion, but the main damage was at its rear, where it was difficult to obtain a picture suitable for reproduction.

The vessel was what is known as a "wet back boiler." The general construction of such a vessel is shown by the line cut, Figure 2. The tubes and flues terminate in an internal tube sheet, "D," and communicate with a combustion chamber, "A," within the shell. The back of this chamber is formed by a sheet, "B," stayed to the rear head, "C." The space between sheet "B" and head "C" is filled with boiler water under pressure and gives the name "wet back" to the type. It was the bursting of this "wet back" and the consequent collapse of the combustion chamber that occasioned the disaster. Its initial cause was the pulling off of sheet "B" from the 172 staybolts which held it.

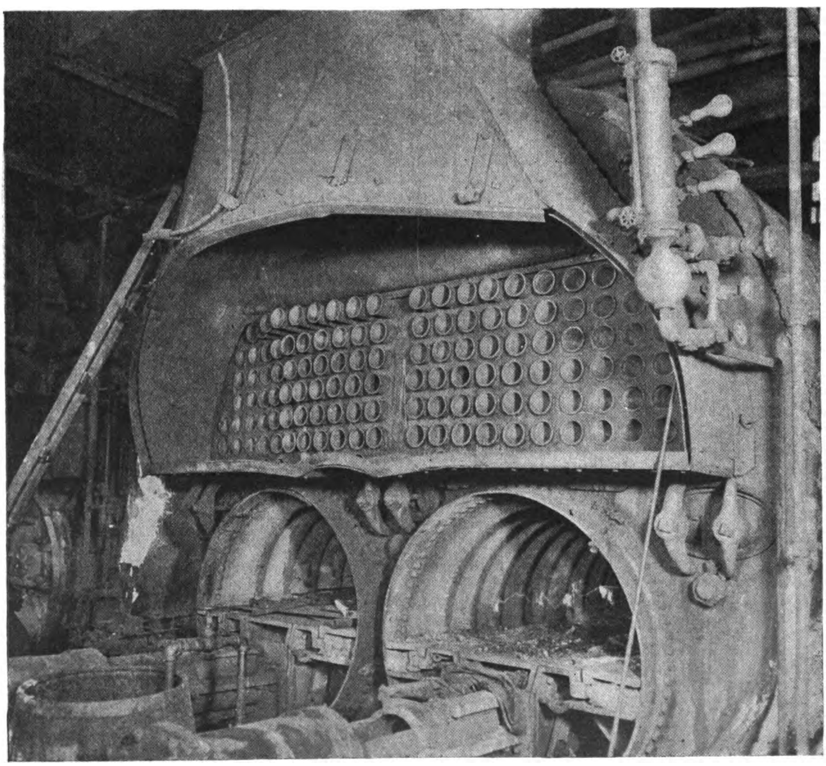


FIG. 1. DAMAGED FRONT OF BOILER.

An investigation disclosed the fact that the holding power of many of these staybolts had been greatly diminished by the buckling of sheet "B" between them, this buckling causing the staybolt holes to take a conical shape with the larger diameter of the cone on the water side of the sheet. This deformation of the holes disengaged the threads to such an extent that those remaining were unable to support the load imposed on them by the boiler pressure.

The boiler at the time of the accident was connected in line with seven others, on which all pop valves were set to 105 lbs. per square inch, so there is a reasonable certainty that the pressure did not exceed this amount. The staybolts on sheet "B" were 1⅛ inches in diameter and spaced 7¼ inches apart each way, and the sheet was 15/32 of an inch in thickness. The only

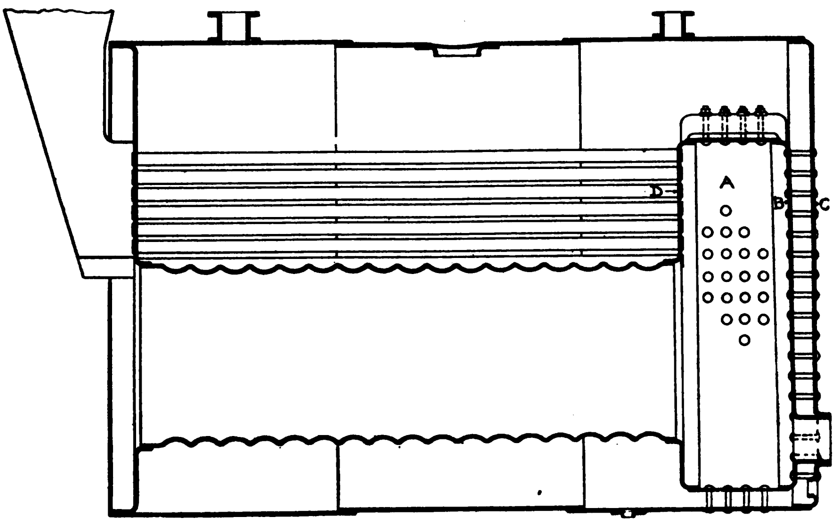


Fig. 2. Section of Boiler.

plausible explanation as to how a pressure which did not exceed 105 lbs. could seriously buckle a sheet of this thickness held by stays in the manner described, is that the sheet was weakened by overheating.

From the data at hand the cause of this overheating cannot be definitely determined, but the boilers were reported clean, and if such was the case, forced driving or low water was probably responsible. Sheet "B" was thrown forward against the rear tube sheet "D" with such force that it drove a number of tubes through the front head, some of them extending as much as six inches from its face. This is shown on the accompanying view of the front of the boiler.

Three men were seriously scalded by this accident, one being so severely injured that he died shortly afterward. The property damage was chiefly confined to the boiler, with the exception of a brick wall located some distance in front, which was thrown down by the force of the explosion. The doors and hoppers of the boiler front were blown through a window twenty feet away.

An Investigation of Electrolysis in Boilers.

W. R. C. CORSON.

About a year and a half ago a case of abnormal tube pitting was brought to the attention of THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY and its assistance asked in seeking the cause and a relief for the trouble. The investigation which followed resulted in the discovery of so unexpected an electrical condition of the affected boilers that it is believed a description of it and of the apparently successful remedy which was applied will be of general interest and suggestion to those who may have steam vessels similarly circumstanced.

At first sight, the trouble appeared but the commonplace pitting which frequently occurs where a "pure water" is used for the feed, and an analysis of it promptly pronounced the water in that category. The action of such waters has been discussed at length in THE LOCOMOTIVE for June, 1896. It is here but necessary to say that it is attributed to the acids or oxidizing gases generated in a boiler from a water which does not carry alkaline salts to neutralize them. In the case in hand, tube pitting was to be expected from the "pure water," but the rapidity of the corrosion aroused the suspicion that some other influence existed to exaggerate that action and as the boilers were in the power house of an electric railway, electrolysis immediately suggested itself among the possibilities.

Now it should not be understood that those who were assigned to this investigation jumped at any conclusion thus suggested. One, at least, of these investigators (the writer admits identity) very much doubted the possibility of any such explanation. The general theory of the action of a current straying from the rails of an electric road was understood, but that it could wander into a boiler and cause any action there was not comprehensible. As THE LOCOMOTIVE once put it in doubting the responsibility of a stray current for the corrosion of an internal feed pipe, "It is hard to understand how an electric action from such a cause could take place within the closed conductor formed by a boiler shell." It was accordingly with a skeptical mind but in a spirit of thoroughness that preparation was made to investigate the electrical situation.

The boilers — three Manning vertical tubulars — were found in a power house typical of street railways of the smaller class. It was located in the rear of a car barn and repair shop which in turn fronted on the highway and main track of the railroad. In the power house a room containing the engines and dynamos was nearest the car barn, and immediately behind it the boiler room. In a rear addition a storage battery was installed for equalizing the load on the station.

Hydrants on the highway at either side of the car barn corroborated the statement of the superintendent that a water main was buried in the street and paralleled his rails for a considerable distance. These hydrants were the points selected for the first of the electrical tests. A low reading voltmeter was used and connected with one terminal in contact with the hydrant and the other with a rail. The object, of course, was to determine whether a difference of electric potential existed between these structures, and if it did, what its value was and which structure was of higher potential. The reading of the instrument fluctuated to some extent but was a maximum at about two volts, with the hydrant at the higher or positive potential. The condition thus indicated was

expected, as it is characteristic of underground piping near a railway power house. The readings if anything were lower than usual, but served to show that the pipe and rail were not metallically connected in that vicinity, and that there was the tendency for a flow of electricity from pipe to rail through the earth.

In a pit near the front of the car barn access was possible to the pipe which supplied the plant with water and which appeared to branch from the main directly in front of the building. Similar tests with similar results were made between this pipe and the rails in the barn, but no sufficient length of this branch pipe was exposed to give opportunity for determining by test whether current was flowing on it or not.

Perhaps it is well here to say for the benefit of the non-technical reader that by potential is meant a sort of electrical pressure, and that where two potentials differ in value there will be — as there would be with two differing pressures of steam or air, for instance — a tendency of flow from the higher to the lower. If there is a path suitable for its conduction between such points, there will be an actual flow of current. Now a pipe, being of metal, is a suitable path for conducting electricity. If, therefore, two points on it are found at differing potentials there is clear evidence of the existence of a current in it. The tests thus far made had disclosed a difference in potential between pipe and rail, and had indicated the probability of a flow of current from the former to the latter, conceiving the ground as a suitable conducting path. It was probable that much of this current came from a distance along the structure of the water main itself, but it was essential to determine whether any flow actually existed on the branch pipe supplying the power house.

Opportunity was given by an exposed feed pipe in the engine room to make such a test and by using an instrument capable of measuring a milivolt (one one-thousandth of a volt), an indication over a short length was had that current was flowing and that it was in the direction of the street.

This was the first surprise for the investigator, for a flow in that direction meant from the boiler room, and his doubt of electrolytic action began to weaken. Further tests along the feed pipe followed — past the pumps and heater and up to the boilers. At the first of these — that in which the pitting was most aggravated — a distinct reading of nearly one milivolt was indicated between a point on its shell and the brass feed pipe near its entrance to the vessel. The instrument needle at this connection, however, was subject to frequent reversals; sometimes the shell was at higher potential, sometimes the pipe. The prevailing indication seemed to show the current flow from boiler to pipe, and the potential difference a maximum in this direction.

Then the instrument was connected between the entering feed pipe at the top of No. 1 boiler and the blowoff pipe at its bottom. The needle of the instrument swung promptly to a maximum of six milivolts and in a direction indicating that the blowoff was at higher potential. Here was certain evidence of a flow of electricity at least through the metallic structure of the boiler from its bottom to its top.

The blowoff pipes on the three boilers ran separately to a brick-lined well on the outside of the building, entering it horizontally about two feet below the surface of the ground. The ends of the pipes were well above the water in it, but from the boiler house they passed through earth which was maintained in a generally wet and conductive condition by the hot vapor with which the

well was filled. Tests made by the milivolt meter between different points on the same blowoff pipe showed current flow from the well, and, while the theory was not proved, it was believed that the electricity was drawn from the earth through its wet contact with that pipe.

Here, then, existed one element of the situation which the writer had doubted. Current was wandering into and through a boiler, and that it was caused by the operation of the railway was evident from the behavior of the instrument used. Its needle, instead of remaining in any fixed and constant position, swung from one point to another as rapidly as that of the switchboard instrument which measured the current supplied to the trolley. The operation of the cars on the road accounted, of course, for the swing of the latter instrument, and it was a fair conclusion that the motion of the milivolt meter was due to the same cause. Had it been perfectly steady, a leak from the lighting wires or from the storage battery cables might have been suspected, but as it was the movement of the needle at times so exactly corresponded to the increments of current occurring when an electric car is started that one could note the steps of the operation as the motorman moved the handle over the controller. However, to be on the safe side, the run of all wires and of the cables from the battery were carefully looked over in an effort to locate any leaks which might reach the boilers and none was found.

It was clear from these tests, then, that an unexpected and unusual electrical condition existed in the boilers. But something unusual was necessary to explain the rapidity of the tube pitting, and so in spite of previous skepticism and present perplexity, the probability of a connection between the one situation and the other had to be admitted. It was still difficult to see how electrolysis "could take place within the closed conductor formed by a boiler shell," but it had been equally difficult to understand how a stray current from the rail could reach the boiler and that seemed to be a proven fact.

It had been shown by the tests that a difference in potential existed between not only the extreme pipe connections, but also between one of them and the boiler shell. Other tests showed similar differences of greater or less value between the other pipe and the shell and even between the pipe and its blowoff cock. The instrument readings were much higher in every case for the No. 1 boiler, but the same general situation was indicated on all three. Of course, these differences were most minute, but it began to be clear that if similar conditions existed in the internal structure of the boiler, the current which produced them might be an influence in the corrosion.

It has been stated that a difference in potential on a conductor is evidence of a flow in it. It is now best to further explain that the magnitude of this difference will depend on two conditions, viz., the amount of current flowing and the resistance offered to its flow by the conductor on which the difference is measured. A small current on a conductor of high resistance may produce a potential difference as great as that of a large current on a conductor of low resistance. This broad statement of these relations seems necessary to explain the reason for an experiment which the situation next suggested.

A piece of trolley wire of No. 0000 gage was bound and soldered at its one end to the feed pipe and at the other to the blowoff pipe of No. 1 boiler. If the difference of potential previously existing between these two pipes was due to a large current flowing over a comparatively low resistance in the boiler structure, the connection of this wire would have little or no effect, for it would not have

influenced the amount of current, and its cross section was so small compared with that of the metal in the boiler that even though of superior conducting material it would but to a small degree reduce the total resistance. On the other hand, if the original potential difference was due to a small current traversing a comparatively high resistance, perhaps due to the various joints and seams of the vessel or the water in it, then the relative improvement of the path by the addition of the wire might be marked. The result proved that the latter situation was the case, for the bond formed by the trolley wire reduced the potential difference between the pipes to practically zero, the instrument needle moving perceptibly, but not enough to determine a value.

Strangely enough, however, the small reversing potential difference which was noted as existing between the boiler shell and the feed pipe did not seem to be affected by the connection. It remained in fact and was clearly indicated by the instrument after the power house had ceased operation for the night, and when all lights were turned off and the storage battery disconnected from its circuit. The only explanation offering was that it was due to galvanic action between the feed pipe, which was of brass, and the steel of the boiler.

Now this paper is more in the nature of a narrative of an investigation than an explanation of the phenomena discovered. It is not difficult to form a probable theory to account for current through the boiler, but to demonstrate it would require more space than is here available. There was such a current undoubtedly, but it may not be so assuredly stated that it by electrolysis produced corrosion. The further investigation showed that the boilers had accumulated a mass of magnetic oxide scale, and that oxide was in evidence at every hot water drip and leak. This substance was not only indicative of the action of acids in the boiler, but by its accumulation there, under the action of the heat, produced further oxidization of the metal parts. It did — and does now — seem probable, however, that there existed the elements essential to electrolytic action — water more or less acid for an electrolyte and metal parts of differing potentials for the electrodes — and that, therefore, there was cause for suspecting such action as an influence in this trouble.

Accordingly, it was recommended that for a time, at least, the wire bond which had been connected as an experiment be allowed to remain. Other remedial measures were also suggested, such as the thorough cleaning of the boilers and the neutralizing of the water in them by the use of soda ash. For while it was appreciated that if all were applied it would be impossible to determine from a resulting improvement which of the remedies had been most effective, it was thought more important to take every measure of protection at once. Those in charge of the boilers, however, apparently had a greater confidence in the wire bond, and took the responsibility of ignoring the other suggestions. That this confidence seems to have been justified by the result is indicated by the following quotation from a letter recently received from the superintendent of the railroad: "The bond which you put in between the blowoff and feed pipe still remains, and as we have had no more trouble from pitting would say the trouble was due to electrolysis. We ran the boiler from August, 1910, [the time of the investigation] until September, 1911, without repairs. Since that time the boiler has been shut down."

Now the facts stated in this quotation may not, perhaps, seem sufficient evidence to justify the superintendent's conclusion as to the responsibility of electrolysis. Taken with the other circumstances they would seem, however,

to indicate a strong probability that such action occasioned the trouble. It is because of this probability, rather than of any positive conclusion, that it is hoped that this description may be suggestive to those who operate steam vessels under similar circumstances.

What's in a Name?

In our long service to the public as specialists in boiler inspection, we have become so familiar with a common form of repair used on return tubular boiler shells, and known as a "Horseshoe Patch," that we have felt we knew all about the matter. Probably many of our inspectors have assumed on account of their experience, that they know perfectly well how the name of such patches was derived, and have considered that the usual shape was the connection that linked the name with that of the metal protection usually attached to the hoof of the noble steed which has served mankind for generations past. It will doubtless be a great surprise to our other friends, as well as to our inspection force, to learn that the relation between the two is much closer than would be indicated by this reasoning. The discovery of the remarkably intimate connection between the name of the patch and the horseshoe was recently made by one of our representatives who was traveling in the south. He was riding on a train in Alabama, and with his head on the back of the car seat, was dozing and dreaming that he had discovered a new material for boiler shells of 100,000 lbs. tensile strength, and as ductile as gold, which would resist corrosion and all other ills to which boiler material is subjected, and that would also pass all state boiler laws, when he was rudely awakened by the sudden stopping of the train. He rubbed his eyes, and looking out of the car window discovered that he was at York; but there were many things missing beside the "New" that indicated he was not near Broadway. However, his eyes finally rested on a sign painted in large letters over the entrance of a brand new one story shop which interested him at once. This sign clearly illustrates how really intimate is the connection between the horseshoe and the boiler patch. The sign was as follows:

YORK BLACKSMITHING CO.

REPAIRS

WAGONS, BUGGIES, BOILERS, ENGINES.

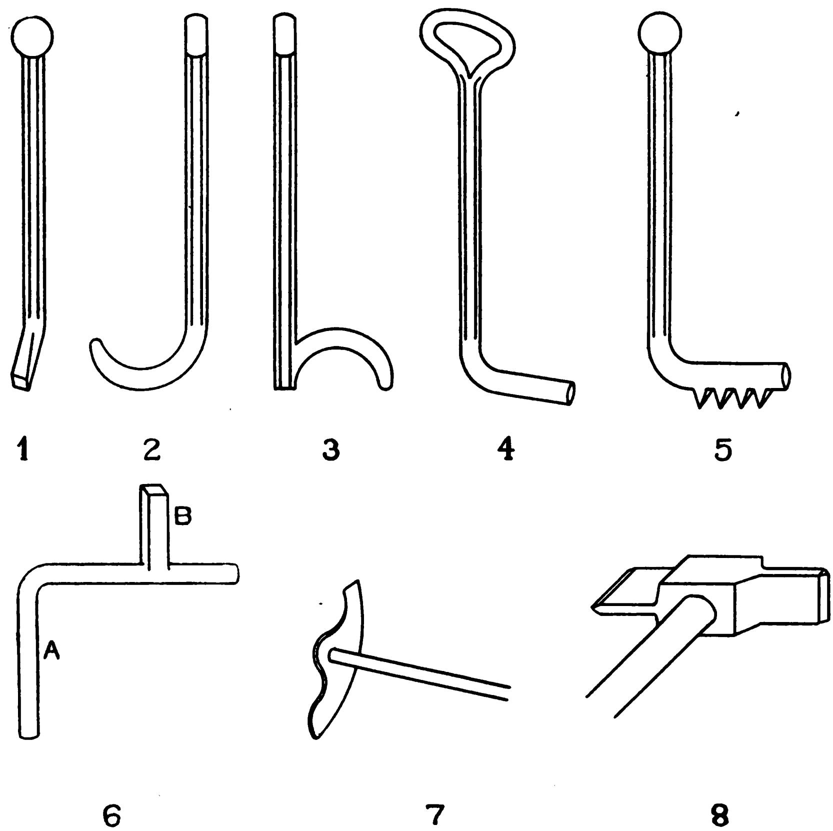
HORSEHOEING A SPECIALTY.

It is evident that the department store idea has penetrated every section of the country and many lines of business. For years past we have been thoroughly familiar with the department store methods used in the insurance field, and aside from the fact that we are not so accustomed to seeing it, the sign given above is not more incongruous than those of our competitors who advertise boiler and flywheel insurance along with an assortment of bonding, liability, accident, plate glass and burglary insurance. Reads like the description of a soup bunch purchased by the frugal housewife, doesn't it?

TOOLS FOR CLEANING BOILERS.

J. W. Hubbard, Inspector.

Much has been published in the mechanical press regarding the need of keeping boilers clean, but aside from descriptions of patented devices, little has been told of the forms of implements suitable for the purpose of cleaning. On account of the lack of information on this subject, many boiler operators are not familiar with the tools which experience has shown to be well suited to the purpose and they are so easily fashioned by a blacksmith that they should be readily procured anywhere.



Cleaning Tools.

The tools described here are not new and doubtless many engineers are thoroughly familiar with them, but they are described with the hope that more engineers may become acquainted with them and learn of their usefulness in keeping their boilers clean and free from scale.

Tool No. 1 is of general utility. The amount of angle near the point and the length of the handle can be varied to meet the requirements of each particular case. The chisel point should be ground sharp and tempered hard. The knob on the end forms a convenient handle, and adds weight to the tool at a point that makes its use effective. The knob should be left soft so that if there is occasion to use a hammer on it, the eyes of the operator will not be endangered by flying particles. All portions of the tube sheet, with the exception of the small surfaces on it between vertically adjacent tubes, can usually be reached for cleaning with this tool. One-half inch hexagonal steel is the proper size stock of which to form this implement.

Tools represented by Nos. 2, 3, and 4 are scrapers for removing the scale from the tubes and should be made of one-half inch hexagonal stock. Nos. 2 and 3 should be sharpened on the concave edges and No. 4 on both edges. By leaving off the loop handle on No. 4 and forming it of five-eighths inch steel, the cutting edge can be driven along the tops of the different rows of tubes against the head, breaking down a part of the scale which cannot be reached by No. 1. With one edge formed, as illustrated in No. 5, it is especially effective for this use.

Tool No. 6 may be used for breaking away heavy scale that may bridge the horizontal space between the tubes away from the heads. This is inserted in the vertical space between the tubes and is turned by the handle "A," which carries the projecting end "B" around in a horizontal plane and forces out the scale between the tubes. The leg "B" should of course be made of such size that it will pass easily between the tubes at points where no scale is adhering.

No. 7 is a convenient form of hoe, for removing loose scale or deposit from the bottom of the shell of horizontal tubular boilers. This tool is particularly convenient for this purpose where the boiler is only provided with a hand-hole communicating with the portion of the shell below the tubes. The points of the blade are cut away so that they may pass under the lower tubes at the side of the boiler and the edge of the blade is made to conform to the curvature of the boiler shell. This latter requirement is important, in order to make the use of this tool effective. The handle should be made of three-quarters inch pipe and the blade of one-quarter inch plate steel. The hole in the blade for the attachment of the handle should be tapped and the pipe screwed into it and held fast with a jam nut. If the space in front of the boiler is sufficient, it is preferable to have the handle of this hoe made of one piece of pipe, but if this is not practicable, it may be made of two or more pieces as required. When working with this hoe, it is often convenient to tie on the handle near the blade a small piece of waste saturated with oil, setting this on fire to light up the interior of the boiler in order to see where to reach for loose material.

A hammer of the type illustrated in No. 8 is very useful for cleaning plates. but for jarring the scale loose from the tubes a flat-faced hammer should be used.

There are, of course, cases where the thorough cleaning of a boiler is impossible owing to either the hardness of the scale or inaccessibility due to design. Boilers in which the tubes are staggered or having poorly designed through bracing above the tubes or in which the tubes have been carried too far down, making the space below them cramped, are inaccessible for cleaning. In boilers of such design where the scale produced is hard, as is the case where

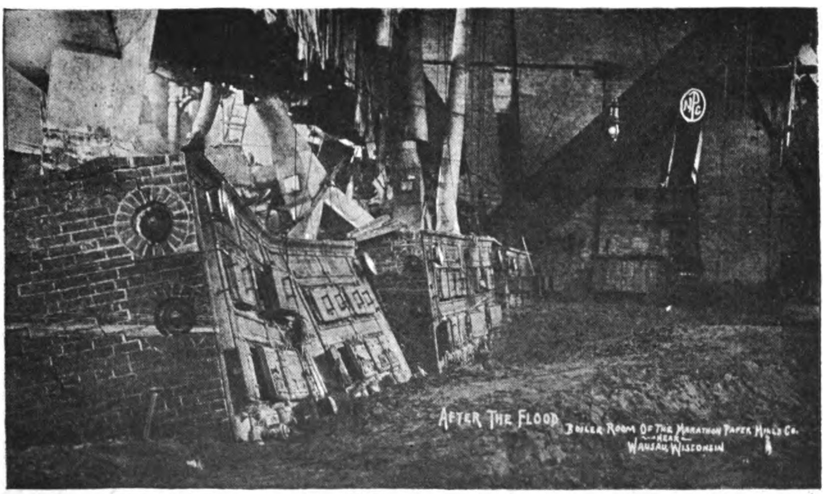
the feed water contains sulphate of lime, it is practically impossible to properly clean them and as a consequence both safety and economy are affected.

The use of such boilers where the feed water supplied is necessarily bad. can only be attributed to lack of care or judgment on the part of those responsible for their installation.

In using the tools here illustrated or any others for a similar purpose, the greatest care should be exercised that the tubes or other portions of the boiler are not injured in the process of cleaning.

A Boiler Disaster From High Water.

The accompanying illustration shows the condition in which the boiler plant of the Marathon Paper Company was left by a flood of the Wisconsin River, on which at Wausau, Wisconsin, that company's mill is located. Unusually heavy rains in the early part of last October had caused high water in all the streams of that neighborhood, and on the sixth of the month the Wisconsin had burst its banks and overflowed the Marathon Company's property, cutting new channels between its buildings, and as it developed, undermining the boiler foundations. Late in the afternoon of that day, before the water had reached the boiler room floor and while steam was still maintained, an initial settlement occurred in the end one of a battery of six boilers. This caused a break in a feed pipe by which three of the attendants were seriously scalded. Soon after, the water invaded the room and operations had to be suspended. At 8:30 in the evening the foundation completely collapsed at the rear, wrecking the



WRECKED BY A FLOOD.

settings and steam piping and tipping the boilers on end as shown in the photograph.

These pages have frequently described the circumstances of a wrecked steam plant, the cause of which was attributed to low water, but it is quite a novelty to record in them a case such as this, where the opposite condition must be held responsible for the misfortune.

Another "Maine" Explosion.

It seems incredible that a foreign government should acquire its munitions of war from among the revered relics of a friendly nation, but that such has been the case at least in one instance, would appear probable from an account of a serious accident published by our English contemporary *Vulcan*. According to that paper, a working party at the Portsmouth (England) Dockyard was engaged in testing "a compressed air cylinder used for propelling torpedoes" when it burst "with a terrific report," killing or injuring eight men. The article continues: "At the inquest the evidence showed that the cylinder was not of the pattern generally used, but was of American make, and evidently came from the hospital ship *Maine*, which formerly belonged to the American Navy." No comment is made on this extraordinary circumstance, but perhaps as a warning to other pilferers of our national souvenirs it is added that the verdict of the jury recommended "the disuse of American cylinders." *Hospital ship, indeed!*

Boiler Room Card.

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY has recently published in condensed form a set of suggestions for the care and management of steam boilers under the title, "Boiler Room Card." As its name implies, this sheet is intended for framing or other mounting, so that it may be hung in the boiler room for the ready reference of the attendants. The "suggestions" cover broadly conditions of maintenance and preservation as well as of safe operation of steam vessels used for power, and embody methods which an extended experience has approved as best practice. They are legibly printed in short paragraphs with prominent captions, so that reference to any particular condition may be easily made.

The Boiler Room Card is, of course, published primarily for the benefit of its policy-holders to whom it is being distributed, but in the belief that it will prove of great value in every plant where boilers are used for power, the Hartford company is glad to furnish copies free to any bona fide boiler owners who will apply for them. If you have not already received one, address the Company at *Hartford, Conn.*, and ask for the "Boiler Room Card," stating in your communication the number and pressure of the boilers you own and where they are located.

Boiler Explosions.

October, 1911.

(376.) — A hot-water boiler burst, October 1, in a "Cafeteria" at Los Angeles, Calif. Two persons were injured and property damaged to the extent of about $500.

(377.) — On or about October 1, a boiler exploded at Mercer's mill, on the Suwanee river, near Branford, Fla. No one was injured.

(378.) — On October 2, a tube ruptured in a water-tube boiler at the Passaic River & Coal street plant of the Public Service Corporation of New Jersey. One man was scalded and died the following day. The property damage was small.

(379.) — A boiler exploded, October 2, in a confectionery store at Sutherland, Iowa. Three persons were injured and machinery and buildings were damaged.

(380.) — A number of cast-iron headers fractured, October 3, in a water-tube boiler at the Louisville Gas Co.'s plant. Louisville, Ky. Considerable damage was done to the boiler.

(381.) — A boiler in the butcher shop of J. A. Spaughy at Postville, Iowa, exploded October 6. Three persons were injured.

(382.) — A boiler ruptured, October 6, at "Waverly Hall," an apartment house at 115 Mount Auburn street, Cambridge, Mass. The damage, which was small, was confined to the boiler.

(383.) — On October 6, a boiler exploded in a school-house at Clark's Summit, Pa.

(384.) — A boiler exploded, October 6, in the Astoria apartment house, Brooklyn, N. Y.

(385.) — A sawmill boiler exploded, October 7, near Waynesburg, Ky. The engineer was instantly killed and several other persons injured.

(386.) — A blow-off pipe failed, October 7, at the Cisco Oil Mill, Carbon, Texas. One man was injured.

(387.) — A small water heater exploded, October 7, in the basement of the residence of M. C. Phillips, Oshkosh, Wis. The heater was practically demolished and considerable damage was done in the basement. No one was injured.

(388.) — A boiler exploded, October 8, in the Thirteenth avenue fire engine house, Oakland, Calif. No person was injured but the fire engine horses were thrown to the ground and the building was damaged.

(389.) — The boiler of a threshing engine exploded, October 8, on William Allen's farm, near Franklinville, N. Y. Mr. Allen was struck by a part of the boiler plate and was thrown about thirty feet. He was seriously but probably not fatally scalded. One other man was slightly injured.

(390.) — On October 9 an accident occurred to a boiler at the Citizens' Ice Co., Oswego, Kansas. The damage was small.

(391.) — The boiler of a locomotive engine exploded, October 10, in the roundhouse of the Los Vegas & Tonopah railroad, at Goldfield, Nev. One man was seriously injured and the roundhouse was wrecked.

(392.) — On October 11 a hot-water heater exploded in the basement of a two-flat building at 5042 Fulton street, Chicago, Ill. Three persons were injured.

(393.) — A valve on a blow-off pipe ruptured, October 12, at the plant of the Michigan Bolt & Nut Co., Detroit, Mich. One man was killed.

(394.) — The boiler of a locomotive on the Louisville & Nashville railroad exploded, October 12, near Knoxville, Tenn. Train Master H. M. Brownlee, who was riding in the engine cab, received scalds which caused his death the following day.

(395.) — A hot-water boiler exploded, October 13, in the residence of E. Augustus Rine, Caldwell, N. J. No one was injured.

(396.) — On October 13 a boiler exploded at the plant of the National Refining Co., Marietta, Ohio, causing large damage to property.

(397.) — A tube ruptured, October 13, in a water-tube boiler at the plant of the Consumers' Hygeia Ice Co., Union Hill, N. J. Three men were injured.

(398.) — A boiler exploded, October 13, in the Stack Block, Lestershire, N. Y., causing a property damage of $200.

(399.) — On October 14 a number of cast-iron headers fractured in a water-tube boiler at the North Delaware avenue power station of the Philadelphia Rapid Transit Co., Philadelphia, Pa.

(400.) — A blow-off pipe failed, October 14, at the Day Chemical Co.'s plant, Westline, Pa. One man was scalded.

(401.) — A cast-iron header ruptured, October 14, in a water-tube boiler at the plant of the American Steel & Wire Co., Waukegan, Ill.

(402.) — One man was severely scalded, October 15, by an accident to the boiler of the tugboat *John Mahar,* at Fulton, N. Y.

(403.) — On October 16 a tube ruptured in a water-tube boiler at the Joseph H. Bromley plant, Philadelphia, Pa.

(404.) — On October 19 one or more boiler tubes blew out on the torpedo boat *Wilkes.*

(405.) — A boiler ruptured, October 19, at the plant of Wm. Goodrich & Co., linseed oil manufacturers, Milwaukee, Wis.

(406.) — On October 20 a boiler exploded in the cellar of the Greenwich Cold Storage Co., Greenwich street, New York City. The boiler, which was located beneath the sidewalk, was blown some distance from its original position, breaking ammonia pipes, a gas main and a high pressure water main, and damaging the Ninth avenue elevated structure. Eight persons were more or less severely injured and the property loss was estimated at $30,000.

(407.) — The boiler of a locomotive engine exploded, October 22, on the Chicago, Milwaukee & St. Paul railroad, at North Homan and Grand avenues, Chicago, Ill. Four men were injured, one of them seriously.

(408.) — On October 22 three tubes ruptured in a water-tube boiler at the planing mill of the Cole Mfg. Co., Memphis, Tenn. The boiler was considerably damaged.

(409.) — A boiler tube burst, October 22, on the torpedo boat *Tingey,* while the vessel was off Charleston, S. C., proceeding to Hampton Roads, Va. One man was killed and another badly scalded.

(410.) — A boiler exploded, October 23, at the Sterling Sugar Refinery, Franklin, La. One man was seriously burned.

(411.) — On October 23 a boiler tube burst on the ferryboat *Peerless,* at Delta, La. One person was killed and seven others injured.

(412.) — A tube ruptured, October 26, in a water-tube boiler at the Guthman Laundry & Dry Cleaning Co.'s plant, Atlanta, Ga. Two men were injured.

(413.) — A cast-iron header ruptured in a water-tube boiler, October 27, at the Utah-Idaho Sugar Co.'s plant, Salt Lake City, Utah.

(414.) — The boiler of a traction engine. belonging to C. Anderson, exploded, October 27, near Waupun, Wis. Two men were severely injured.

(415.) — On October 28 a tube ruptured in a water-tube boiler at the State Hospital for Insane, Athens, Ohio.

(416.) — A boiler exploded, October 28, at the Hintze greenhouses, Fond du Lac, Wis. Damage to property was estimated at $2,000.

(417.) —The boiler of a locomotive on the Trinity & Brazos Valley railroad exploded, October 28, near Karen, Texas. Three men were killed.

(418.) — On October 30 a boiler exploded on the Pure Oil Co.'s steamer No. 5, at East Newark, N. J. One person was killed and five others were injured, three of them fatally.

(419.) — A boiler tube blew out, October 30, in the plant of John Diebold & Sons, Louisville, Ky. No one was injured.

(420.) — On October 31 a tube ruptured in a water-tube boiler at the sugar house of the St. Joseph Planting & Mfg. Co., Feitel, La.

(See also No. 427.)

(421.) — On October 31 the boiler of locomotive No. 852, on the Wabash railroad, exploded near Riverton, Ill. The engineer was killed and the fireman and head brakeman severely injured. The property damage was estimated at $10,000.

(422.) — The boiler of a freight locomotive on the Pennsylvania railroad exploded, October 31, at Elizabeth, N. J. Three men were severely injured.

(423.) — On October 31 a boiler exploded on the premises of Walter Oderwald, Clifton, Ill. One person was seriously injured.

NOVEMBER, 1911.

(424.) — The boiler of a freight locomotive exploded, November 1, on the Pennsylvania railroad near Lima, Ohio. Three men were seriously injured.

(425.) — A boiler exploded, November 1, at the plant of the Mt. Clemens Sugar Co., Mt. Clemens, Mich. Three men were seriously injured, one of whom has since died.

(426.) — A heating boiler exploded, November 1, in the basement of the high school at Niagara Falls, N. Y. One man was seriously and another slightly injured.

(427.) — On November 2 a tube ruptured in a water-tube boiler at the sugar house of the St. Joseph Planting & Mfg. Co., Feitel, La.

(See also No. 420.)

(428.) — A locomotive boiler exploded, November 3, on the premises of the W. R. Pickering Lumber Co., Pickering, La. One man was injured.

(429.) — A cast-iron elbow of a blow-off pipe failed, November 3, at the flax spinning mill of Smith & Dove Mfg. Co., Andover, Mass. One man was fatally injured.

(430.) — On November 4 a section cracked in a cast-iron heating boiler in the hotel of Rafter & Co., Nevada, Mo.

(431.) — The explosion of a small vertical boiler, November 4, at Zincite, Mo., near the Lincoln mine, seriously injured one man.

(432.) — A heater exploded, November 4, at 359 Massachusetts avenue, Indianapolis, Ind. One person was injured.

(433.) — A boiler belonging to the Standard Oil Company exploded, November 5, at St. Paul, Minn., causing a property loss of $150.

(434.) — A boiler flue failed, November 5, on the Cauvel farm, near Oil City, Pa. No one was injured.

(435.) — A boiler flue failed, November 6, on the Cauvel farm, near Oil City, Pa. One man was severely burned.

(Items Nos. 434 and 435 refer to the same boiler, the two accidents occurring on two consecutive days. After the first accident the boiler flue was repaired and the boiler again put in service, with the result noted.)

(436.) — A locomotive boiler exploded, November 6, on the Baltimore & Ohio railroad, at Brooklyn Junction, W. Va. Two persons were seriously injured.

(437.) — A tube ruptured, November 6, in a water-tube boiler at the plant of the Southern Iron & Steel Co., Alabama City, Ala.

(438.) — A boiler owned by W. N. McCann exploded, November 6, at St. Joseph, Mo. The property damage was estimated at $3,000.

(439.) — A boiler tube failed, November 6, in the power house of the Consolidated Company, Charleston, S. C. No one was injured.

(440.) — On November 8 a tube ruptured in a vertical boiler at the Oak Park Power Co.'s plant of the General Motors Company of Michigan, Flint, Mich. The boiler was used in connection with a producer gas plant. Considerable damage was done to the boiler and surrounding property.

(441.) — A Pennsylvania railroad locomotive boiler exploded, November 8, at Worthington, Ill. One person was seriously injured.

(442.) — A tube ruptured, November 8, in a water-tube boiler in the basement of the "Ellicott Square," one of the largest office buildings in Buffalo, N. Y. One man was scalded. (See item No. 444.)

(443.) — The boiler of the locomotive drawing the St. Louis & San Francisco railroad's fast train, "Meteor," exploded, November 9, near Fort Scott, Kans. The engineer and fireman were killed.

(444.) — On November 10 a tube ruptured in a water-tube boiler in the "Ellicott Square" office building, Buffalo, N. Y. Arthur Brady, a boiler maker, was killed, John Schrott, a boiler maker, and Bard Leavitt, an inspector for The Hartford Steam Boiler Inspection & Insurance Company, were severely scalded, Schrott dying a few days later.

(See Item No. 442.)

(445.) — On November 10 a boiler ruptured at the American Terra Cotta & Ceramic Co.'s plant, Terra Cotta, Ill.

(446.) — The boiler of the forward locomotive of a double-headed freight train exploded, November 11, twenty miles west of Lynchburg, Va., on the Norfolk & Western railroad. One man was killed, one critically scalded, and several other persons received minor injuries.

(447.) — A cast-iron heating boiler exploded, November 12, at the residence of Eber Downs, Kewanee, Ill. No one was injured.

(448.) — A blow-off pipe failed, November 13, in the hothouse of Hoerber Brothers, Des Plaines, Ill. Two men were slightly scalded.

(449.) — On November 13 a tube ruptured in a water-tube boiler at the Glen Allen Oil Mill, Glen Allen, Miss. One man was scalded.

(450.) — On November 15 three sections of a cast-iron heating boiler fractured at the Masonic Temple, Greenville, S. C.

(451.) — Four men were fatally scalded, November 16, by the bursting of a boiler tube in a boiler owned by Scott Brothers, canal contractors. The boiler was in use on the Seneca River section of the barge canal, near Seneca Falls, New York.

(452.) — A boiler exploded, November 16, on dredge No. 3, of the Fitzsimmons & Connell Dredge & Dock Co., at Madison street bridge, Chicago, Ill. Four men were slightly burned.

(453.) — On November 19 a mud drum, attached to a boiler, ruptured on the sugar plantation of the Estate of H. C. Minor, Houma, La.

(454.) — The boiler of the locomotive of the Overland Limited on the Union Pacific Railroad exploded on the morning of November 20 near Rawlins, Wyo., severely scalding the engineer and fireman.

(455.) — A heating boiler exploded, November 21, in St. James' Parish School, St. Louis, Mo. No one was injured.

(456.) — The boiler of a Big Four locomotive exploded, November 22, near Fortsville, Ind. Three trainmen were seriously injured.

(457.) — A tube ruptured, November 27, in a water-tube boiler at the Inman Mills, Inman, S. C. The fireman was injured.

(458.) — A boiler on the farm of Oliver Launstein, at Owosso, Mich., exploded, November 27. Mr. Launstein was painfully but not seriously injured.

(459.) — The boiler of a locomotive exploded, November 29, while standing in the yards at Creston, Ill. The engineer was badly burned and the fireman sustained slight burns and scalds.

(460.) — Two boilers exploded, November 29, in the Lower Merion Y. M. C. A. building, Ardmore, Pa. No one was seriously injured but the property loss was estimated at $5,000.

(461.) — On November 29 the boiler of a locomotive on the Lake Erie, Alliance & Wheeling railroad exploded, near Wattsville, Ohio. The engineer was seriously injured and the firemen was badly scalded.

(462.) — The boiler at the gin of C. L. Davis, near Bonham, Texas, exploded, on or about November 30. No one was injured. Damage to property was estimated at $1,800.

The record of boiler explosions for December, 1911, and the summary and statistics of such disasters for the past year, which have previously found a place in the January issue, will appear in that for April, 1912. The verification of the latest explosions and the compilation of the complete data would cause a delay in the current number which we believe unadvisable.

The Locomotive of The Hartford Steam Boiler Inspection and Insurance Co.

HARTFORD, JANUARY, 1912.

SINGLE COPIES *can be obtained free by calling at any of the company's agencies.*
Subscription price 50 cents per year when mailed from this office.
Recent bound volumes one dollar each. Earlier ones two dollars.
Reprinting of matter from this paper is permitted if credited to
THE LOCOMOTIVE OF THE HARTFORD STEAM BOILER I. & I. CO.

We call attention to the enlarged title appearing on this, the first number of a new volume. The old familiar name of the periodical is retained, but incorporated with it is also the name of the institution responsible for its publication. This change from the shorter title of the past forty-four years is symbolic of our desire and purpose that hereafter THE LOCOMOTIVE shall be more closely identified with THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY and more representative of the activities of that corporation and of its views on the mechanical and insurance conditions essential to the protection of power apparatus.

The reason for the purchase of protection against loss from damages for personal injury in a boiler insurance contract, by the holder of a liability policy, obviously is to supplement the protection afforded by the latter in those cases of serious boiler disaster for which the liability policy limits may prove insufficient or inapplicable. It cannot be with any desire to assist the liability company by contributions from other insurance in the settlement of claims that such purchaser expends his money in additional premiums; and yet when he selects a boiler policy in which the personal injury insurance is made to contribute proportionately with the liability insurance, he may be defeating his very purpose and be practically reinsuring the liability risk in a manner which leaves himself not fully indemnified for personal injury claims, although with an unconsumed balance of liability insurance. Moreover, for the minor boiler accidents, such as tube, blowoff pipe, and water glass explosions, the limits of the liability policy alone would generally afford ample protection, without in any way diminishing the amount of liability insurance in force for future accidents; for while liability insurance policies limit the amounts payable for injuries or death of one person, or of several persons hurt in one accident, there is no limit to the number of persons or accidents covered and thus no limit to the amount the liability insurance company might have to pay during the term of its policy. On the other hand, steam boiler policies necessarily insure for a definite amount to cover all accidents during the period for which the policy is in force, and what is paid on one accident is deducted from this amount. Thus every time the

boiler insurance is called upon to help the liability insurance company settle a loss, the boiler explosion protection that the assured has paid for is diminished for the benefit of the liability company, without any compensating benefit to the assured for the depletion of his insurance against subsequent loss from boiler explosions.

This situation is due to the provisions commonly incorporated in each form of contract that where other insurance is applicable the assured cannot recover a larger proportion of the loss under one policy than the insurance available under it bears to the total available under all policies. Such has been the commonly adopted provision of boiler policies.

The Hartford Steam Boiler Inspection and Insurance Company, realizing this deficiency in the older forms, has recently put out an improved contract which in addition to the usual indemnity against property loss, affords insurance against loss from death and personal injury in a manner which, while as fully as any other protecting the assured where no liability policy exists or where it is inadequate or inapplicable, does not force contributions from the assured's boiler insurance to the liability company's losses.

A complete discussion of this whole matter has been made by President Brainerd and published by The Hartford Steam Boiler Inspection and Insurance Company in a pamphlet entitled "The Excess or Non-Contributing Form of Policy versus The Concurrent and Contributing Forms." Every steam user who protects himself both by boiler and liability insurance should read this pamphlet and carefully consider its contents. It may be obtained from any of the offices of the Company, which are listed on the last (cover) page of this issue.

From time to time, we are asked for an opinion as to the relative responsibility of owner and tenant, with regard to the explosion of a boiler. As a general proposition, if, after the explosion, it can be shown that the boiler was in excellent condition, but care and management were bad, the tenant would be held liable. On the other hand, if, after the explosion, it can be shown that the care and management were excellent, but the design and construction of the boiler poor, the owners might be held, but it is one of those cases which depends entirely upon circumstances, which circumstances are brought out by the explosion, and cannot be predicted beforehand.

As a concrete case report No. 642 to the Secretary of the British Board of Trade is of interest. That report describes the explosion of a boiler in a corn mill, caused by the wasting of the shell plates due to corrosion. The Court blamed the owner for neglecting to have the boiler examined and he was ordered to pay. The tenant was blamed for neglecting to ensure that the boiler was working under safe condition, and he also was ordered to pay.

It is safe to say, therefore, that for full protection of both the owner and the tenant, the interest of each should be covered by a boiler policy.

No good business man would make a loan on property which was not protected by fire insurance, yet loans are made on property containing steam boilers, where no insurance protection against their explosion exists. This too in the face of the obvious fact that the effect of a boiler explosion is immediate and

almost instantaneous with the event itself, while with a fire subsequent to its discovery efficient measures may be taken to minimize the resulting loss.

One explanation why boiler insurance is not carried in such cases lies in the mistaken idea that after a boiler explosion, fire will likely ensue, and the total loss will then be collectible from the fire insurance companies. This is not the case, however. A fire policy takes hold where the boiler policy leaves off, so that if a boiler explodes in a building which was worth say, $50,000, and if after the explosion the building because of its wrecked condition is worth but $4,000, the latter amount only would be collectible under a fire insurance policy for a fire which completed the destruction.

This is a matter which should receive the attention of bankers and others who, though not owning steam plants, may loan money on them. They should see that the property which secures the loan is itself secure from the effects of a boiler disaster by adequate insurance under a steam boiler policy.

Obituary.

Benjamin F. Cooper, late Chief Inspector of THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY, at Cincinnati, Ohio, died suddenly of heart failure in that city November 1, 1911.

Mr. Cooper was born in Kenton County, Kentucky, in 1844. Prepared by a good common school education and an apprenticeship to the machinist trade, he early took up the work of a stationary engineer. In this he became most proficient and held many important engineering positions. In 1883 he entered the service of the Hartford company at Cincinnati, and in 1909 received his appointment as Chief Inspector of that department.

Mr. Cooper served during the Civil War from 1862 to 1865 as a private in the 4th Ohio Cavalry, and ever after remained a loyal comrade of his associates in that great struggle and a zealous member of the Grand Army of the Republic. He was prominent in Masonic circles and held in high esteem for his many sterling qualities of heart and mind by a broad circle of friends and associates. Many of our assured, who have benefited by consultation with Mr. Cooper on matters pertaining to their steam plants, and who have thus come to know the value of his advice and his carefully formed opinion, will feel with the Hartford company that in his death has been lost a good friend, a painstaking official, and a conscientious adviser.

Mr. Cooper was buried with the honors of the Grand Army of the Republic by his comrades of the Cincinnati local post. He is survived by two sons, Cassius G. Cooper of Chicago, and Frank P. Cooper of Cincinnati.

Personal.

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY regrets to announce that Allan D. Risteen, Ph.D., who for the last twenty-three years has been in the service of the Company as Assistant Editor and Editor of "THE LOCOMOTIVE," has severed this connection. Dr. Risteen is an expert

mathematician and a versatile writer and lecturer in other branches of science. He has been a contributor to many technical journals and encyclopaedias and has now in course of preparation a new encyclopaedia of his own, covering in condensed form the fields of history, literature, and science. His articles in THE LOCOMOTIVE have been highly regarded from an academic as well as a practical standpoint, and have been a potent influence in obtaining for that paper a place of merited appreciation in the libraries of the higher technical schools and colleges.

In leaving the "Hartford" Dr. Risteen bears with him the high regard of its officers and of his associates and the sincere good wishes of all for his future success and happiness.

In December, 1911, Walter Gerner was appointed by THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY, Chief Inspector at its Cincinnati office, vice Benjamin F. Cooper, deceased.

Mr. Gerner's early career was largely connected with the sea, during which he advanced through the several grades of marine engineering to that of chief engineer of trans-Atlantic vessels, including in the duties of the latter position the supervision of construction and repair of the vessels of the line with which he was connected.

During his service with this Company, Mr. Gerner has acquired a broad experience with inspection work in field, shop, and office. By this and his engineering training he is well equipped to serve the interests of our patrons in his new territory.

William A. Craig, who has been connected with its inspection force since 1893, has been promoted by THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY to the position of Assistant Chief Inspector of its Pittsburg department. We are sure Mr. Craig's advancement will receive the general approval of his associates in our Company and of his many friends among the steam users of his district.

On December 31, 1911, Inspector Johnston Nolan resigned from the force of our Philadelphia department in order to engage more actively in the manufacture and sale of a blowoff valve which he has invented. We learn that his valve has met with favorable consideration, and we wish Mr. Nolan all success in his undertaking.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES. A valuable indexed hand-book of 196 pages of convenient size (3½" x 5¾") and substantially bound, containing a brief history of the Metric System, and *comparative tables* carefully calculated, giving the English or United States equivalents in all the units of measurement.

Everyone who has had occasion to convert English weights and measures into their metric equivalents, and conversely, is familiar with the irritation produced, either by the necessity of calculating them, or by finding that the particular units required are not included in the tables at hand. But the tables in this hand-book are so numerous that this annoyance will be reduced to its lowest terms. The book is of convenient pocket size and well bound.

Published and for sale by *The Hartford Steam Boiler Inspection & Ins. Co., Hartford, Conn. U. S. A.* . . . . . . Price $1.25.

Boiler Explosion Injures Inspector.

Although not without precedent, it is rare that a boiler inspector is injured in an explosion. An accident with this result occurred on November 10th at the Ellicott Square office building at Buffalo, New York, when one of our local inspectors, Bard Leavitt, was seriously scalded by the bursting of a tube in a water-tube boiler next to one which he was inspecting. Two boiler makers, Arthur Brady and John Schrott, were working on the boiler with the inspector. Both lost their lives, Mr. Brady being killed outright and Mr. Schrott dying several days later.

Inspector Leavitt was particularly fortunate to escape with his life, as he was under the tubes in the back connection when the explosion occurred. In order to escape, it was necessary for him to crawl through a cleaning door about 18 inches square, into a narrow passageway which was filled with steam and hot water from the explosion. Mr. Leavitt was so blinded by the steam and the pain of his injuries that in leaving the boiler room he ran into a pumping engine which was in motion, and severely cut his mouth and nose on the connecting rod or the crank pin.

We are glad to state that Mr. Leavitt is on the road to recovery.

Inspection Work for the year 1911.

The activity of the inspection force of THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY for the year just closed is evidenced in the statistical tables of the following pages. This data is compiled from the record of the work accomplished and is published in this form that those who are interested in such matters may obtain a realization of the magnitude and value of the service which is performed by our inspectors in the boiler plants of the United States.

The summaries on page 25 are particularly interesting. From a comparison of their figures it appears that an inspector on the average found something defective at nearly every visit he made, and in every ten a condition which if continued was dangerous to the operation of the vessel. These figures are significant, for the breadth of the field covered by the tabulated experience is great enough to represent the average situation of the steam vessels of the country. If once out of ten visits to a boiler room a trained inspector discovers a dangerous condition the necessity and value of his visitation is emphasized, without mention of the benefit derived at every visit from his warning of a defect which may be remedied before it reaches a critical stage.

From the summary of defects the character of the several diseases which afflict boilers may be seen and an idea gained of the relative frequency with which each occurs and the probability of its attaining a dangerous state. The predominance of defects due to impure water is most marked.

These statistics are of the work among steam boilers, meaning by that term, steam containing vessels generally. In addition the inspection force of the company has made during the year 92 examinations of steam pipe lines, economizers, and miscellaneous apparatus, and 4,234 inspections of fly-wheels and pulleys.

Summary of Inspectors' Work for 1911.

Visits of inspection made,	180,842
Whole number of inspections (both internal and external).	352,674
Number of complete internal inspections,	140,896
Boilers tested by hydrostatic pressure,	12,724
Total number of boilers condemned,	653
Total number of defects discovered,	164,713
Total number of dangerous defects discovered,	17,410

Summary of Defects Discovered.

Nature of Defects.	Whole Number.	Dangerous.
Cases of deposit of sediment,	19,710	1,400
Cases of incrustation and scale,	42,879	1,699
Cases of internal grooving,	2,756	305
Cases of internal corrosion,	14,083	649
Cases of external corrosion,	9,755	898
Defective braces and stays,	2,485	545
Settings defective,	5,686	731
Furnaces out of shape,	7,191	397
Fractured plates,	3,479	440
Burned plates,	4,837	477
Laminated plates,	509	44
Cases of defective riveting,	3,026	636
Defective heads,	1,349	234
Cases of leakage around tubes,	11,188	1,627
Cases of defective tubes,	9,447	2,935
Tubes too light,	1,901	521
Leakage at joints,	5,417	373
Water-gages defective,	3,447	773
Blow-offs defective,	4,509	1,373
Cases of deficiency of water,	313	90
Safety-valves overloaded,	1,124	319
Safety-valves defective,	1,225	329
Pressure gages defective,	7,836	525
Boilers without pressure gages,	532	71
Unclassified defects,	29	19
Total.	164,713	17,410

Grand Total of the Inspectors' Work from the Time the Company Began Business, to January 1, 1912.

Visits of inspection made,	3,312,922
Whole number of inspections (both internal and external),	6,413,587
Complete internal inspections,	2,518,922
Boilers tested by hydrostatic pressure,	299,852
Total number of boilers condemned,	21,620
Total number of defects discovered,	3,987,980
Total number of dangerous defects discovered.	409,639

Inspectors' Reports for January, February, and March, 1911.

Nature of Defects.	January.		February.		March.	
	Total defects.	Dangerous.	Total defects.	Dangerous.	Total defects.	Dangerous.
Cases of deposit of sediment,	1,702	114	1,495	108	1,586	97
Cases of incrustation and scale,	3,761	127	3,315	106	3,452	122
Cases of internal grooving,	207	26	210	15	215	17
Cases of internal corrosion,	1,111	83	988	39	1,005	39
Cases of external corrosion,	791	86	675	62	795	71
Defective braces and stays,	227	41	177	67	194	44
Settings defective,	499	60	428	54	430	48
Furnaces out of shape,	600	30	531	25	608	30
Fractured plates,	312	30	322	43	300	42
Burned plates,	482	61	364	40	361	38
Laminated plates,	70	5	45	5	36	1
Cases of defective riveting,	325	82	341	77	255	46
Defective heads,	123	21	118	21	127	16
Cases of leakage around tubes,	1,071	150	990	136	955	146
Cases of defective tubes,	910	331	714	205	830	270
Tubes too light,	161	66	160	37	178	77
Leakage at joints,	505	43	451	31	537	29
Water-gages defective,	317	78	259	60	313	56
Blow-offs defective,	388	138	335	115	362	97
Cases of deficiency of water,	32	14	27	8	22	9
Safety-valves overloaded,	90	26	77	21	116	29
Safety-valves defective,	118	41	105	32	87	20
Pressure gages defective,	663	48	668	62	698	55
Boilers without pressure gages,	39	14	98	27	16	2
Unclassified defects,	1	1	2	1	0	0
Totals,	14,505	1,716	12,895	1,397	13,478	1,401

Inspectors' Reports for April, May, and June, 1911.

Nature of Defects.	April.		May.		June.	
	Total defects.	Dangerous.	Total defects.	Dangerous.	Total defects.	Dangerous.
Cases of deposit of sediment,	1,746	122	1,669	116	1,791	126
Cases of incrustation and scale,	3,959	270	3,802	131	3,957	112
Cases of internal grooving,	267	45	294	48	280	29
Cases of internal corrosion,	1,220	60	1,266	70	1,686	60
Cases of external corrosion,	841	82	790	65	969	88
Defective braces and stays,	294	60	242	48	187	39
Settings defective,	533	76	482	75	517	56
Furnaces out of shape,	736	46	523	26	655	45
Fractured plates,	304	38	288	32	252	42
Burned plates,	443	56	421	45	396	27
Laminated plates,	37	5	46	5	42	1
Cases of defective riveting,	287	65	269	41	243	39
Defective heads,	110	14	91	16	120	22
Cases of leakage around tubes,	1,025	132	1,004	112	861	113
Cases of defective tubes,	892	229	775	220	796	237
Tubes too light,	160	34	113	23	142	51
Leakage at joints,	503	37	461	23	431	36
Water-gages defective,	293	63	242	50	269	71
Blow-offs defective,	425	112	371	124	420	132
Cases of deficiency of water,	25	8	23	6	27	7
Safety-valves overloaded,	103	28	87	16	82	23
Safety-valves defective,	106	17	88	29	97	23
Pressure gages defective,	701	45	682	38	643	43
Boilers without pressure gages,	28	2	26	1	64	7
Unclassified defects,	4	4	8	2	2	2
Totals,	15,042	1,650	14,063	1,362	14,929	1,431

Inspectors' Reports for July, August, and September, 1911.

Nature of Defects.	July.		August.		September.	
	Total defects.	Dangerous.	Total defects.	Dangerous.	Total defects.	Dangerous.
Cases of deposit of sediment,	1,803	151	1,586	95	1,624	124
Cases of incrustation and scale,	4,083	170	3,519	119	3,378	135
Cases of internal grooving,	219	22	237	24	201	17
Cases of internal corrosion,	1,568	66	1,277	65	1,150	54
Cases of external corrosion,	950	81	959	128	762	60
Defective braces and stays,	190	31	180	48	194	43
Settings defective,	514	77	455	46	450	51
Furnaces out of shape,	738	43	601	43	583	30
Fractured plates,	284	36	283	34	268	32
Burned plates,	401	30	387	27	407	34
Laminated plates,	63	5	38	4	34	4
Cases of defective riveting,	200	43	181	39	275	62
Defective heads,	100	11	108	25	119	20
Cases of leakage around tubes,	826	156	918	121	876	129
Cases of defective tubes,	733	190	791	210	679	199
Tubes too light,	140	41	281	51	207	53
Leakage at joints,	413	29	396	25	396	27
Water-gages defective,	295	78	328	65	263	70
Blow-offs defective,	385	108	398	125	355	101
Cases of deficiency of water,	21	8	32	5	21	8
Safety-valves overloaded,	91	26	93	29	86	28
Safety-valves defective,	102	21	117	35	110	29
Pressure gages defective,	648	36	613	39	618	39
Boilers without pressure gages,	32	4	22	2	29	5
Unclassified defects,	2	2	2	2	2	2
Totals,	14,801	1,465	13,802	1,406	13,087	1,356

Inspectors' Reports for October, November, and December, 1911.

Nature of Defects.	October.		November.		December.	
	Total defects.	Dangerous.	Total defects.	Dangerous.	Total defects.	Dangerous.
Cases of deposit of sediment,	1,800	140	1,544	109	1,364	98
Cases of incrustation and scale,	3,412	151	3,200	123	3,041	133
Cases of internal grooving,	219	20	187	22	220	20
Cases of internal corrosion,	1,022	34	866	35	924	44
Cases of external corrosion,	739	58	786	61	698	56
Defective braces and stays,	205	50	189	35	206	39
Settings defective,	506	56	449	63	423	69
Furnaces out of shape,	584	24	573	24	459	31
Fractured plates,	253	25	330	39	283	47
Burned plates,	379	43	405	37	391	39
Laminated plates,	35	5	32	2	31	2
Cases of defective riveting,	167	31	276	63	207	48
Defective heads,	126	29	96	5	111	34
Cases of leakage around tubes,	918	160	943	160	801	112
Cases of defective tubes,	817	306	720	299	790	239
Tubes too light,	148	23	107	33	104	32
Leakage at joints,	443	28	488	31	393	34
Water-gages defective,	324	65	289	60	255	57
Blow-offs defective,	390	121	356	95	324	105
Cases of deficiency of water,	25	5	35	5	23	7
Safety-valves overloaded,	111	25	110	40	78	28
Safety-valves defective,	89	28	107	22	99	32
Pressure-gages defective,	731	47	653	32	518	41
Boilers without pressure-gages,	60	4	62	2	56	1
Unclassified defects,	2	2	0	0	4	1
Totals,	13,505	1,480	12,803	1,397	11,803	1,349

(126.) — A boiler owned by the Carter Oil Co., exploded, February 19, on the Carson farm at Trail Run, near Sistersville, W. Va. One man was killed and another probably fatally injured.

(127.) — On February 21 a boiler tube ruptured in the Glenwood power house of the Pittsburg Railway Companies. Four men were injured, one of them seriously.

(128.) — A tube in a water-tube boiler ruptured, February 22, in the plant of the Minneapolis Malt & Grain Co., Minneapolis, Minn.

(129.) — On February 23 a tube in a water-tube boiler ruptured in the stamp mill of the Baltic Mining Co., Baltic, Mich.

(130.) — A blowoff pipe ruptured, February 23, in the cotton bleachery of The Bronx Co., New York City. One man was slightly injured.

(131.) — On February 24 a blowoff pipe ruptured at the plant of the Lewiston Gas Light Co., Lewiston, Me.

(132.) — A hot-water heater exploded, February 24, in the residence of William Bower, on Red Lion Road, Philadelphia, Pa. The explosion caused a fire which resulted in a property loss estimated at $17,000.

(133.) — On February 26 a slight accident occurred to a boiler at the Medina County Infirmary, Medina, Ohio.

(134.) — A tube in a water-tube boiler ruptured, February 26, at the Inman Mills, Inman, S. C.

(135.) — On February 26 the boiler of a freight locomotive on the Trinity & Brazos Valley railroad exploded at Chambers Creek, about fifteen miles north of Corsicana, Texas. One man was killed and four others injured.

(136.) — On February 28 a boiler exploded in the flour mill of the Rea & Page Milling Co., Marshall, Mo.

(137.) — On February 29 three tubes ruptured in a boiler at the Fox Co.'s paper mill, Lockland, Ohio. Two men were scalded.

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY is now issuing to its policy-holders its "Vacation Schedule" for 1912. Like those of previous years, this schedule affords a most convenient form for arranging and recording the holiday period allotted to each of the clerks or other employees of an institution. From it at a glance may be determined how many and what members of the force will be absent on any given date and thus by a little foresight and care the assignment of the same days to those whose simultaneous absence would cause inconvenience may be avoided. That this publication is appreciated by its recipients is shown by the following quotation from one of many similar letters which the HARTFORD Company has received:

> "We acknowledge receipt of your letter of 8th, and copies of your vacation schedule, which we received under separate cover and for which we wish to thank you very much. Your idea is the best we have seen for keeping record of the vacations, and your furnishing us with the blanks saves us considerable work in making them up for ourselves."

Copies may be obtained by our policy-holders on application to the nearest of the offices listed on the last page of this issue.

The Hartford Steam Boiler Inspection and Insurance Company.

ABSTRACT OF STATEMENT, JANUARY 1, 1912.

Capital Stock, ... $1,000,000.00.

ASSETS.

Cash on hand and in course of transmission, ...		$204,693.25
Premiums in course of collection, ...		263,453.33
Real estate, ...		91,100.00
Loaned on bond and mortgage, ...		1,166,360.00
Stocks and bonds, market value, ...		3,249,216.00
Interest accrued, ...		71,052.02
Total Assets, ...		$5,045,874.60

LIABILITIES.

Premium Reserve, ...		$2,042,218.21
Losses unadjusted, ...		102,472.53
Commissions and brokerage, ...		52,690.67
Other liabilities (taxes accrued, etc.), ...		47,191.65
Capital Stock, ...	$1,000,000.00	
Surplus over all liabilities, ...	1,801,301.54	
Surplus as regards Policy-holders, . . .	**$2,801,301.54**	2,801,301.54
Total Liabilities, ...		$5,045,874.60

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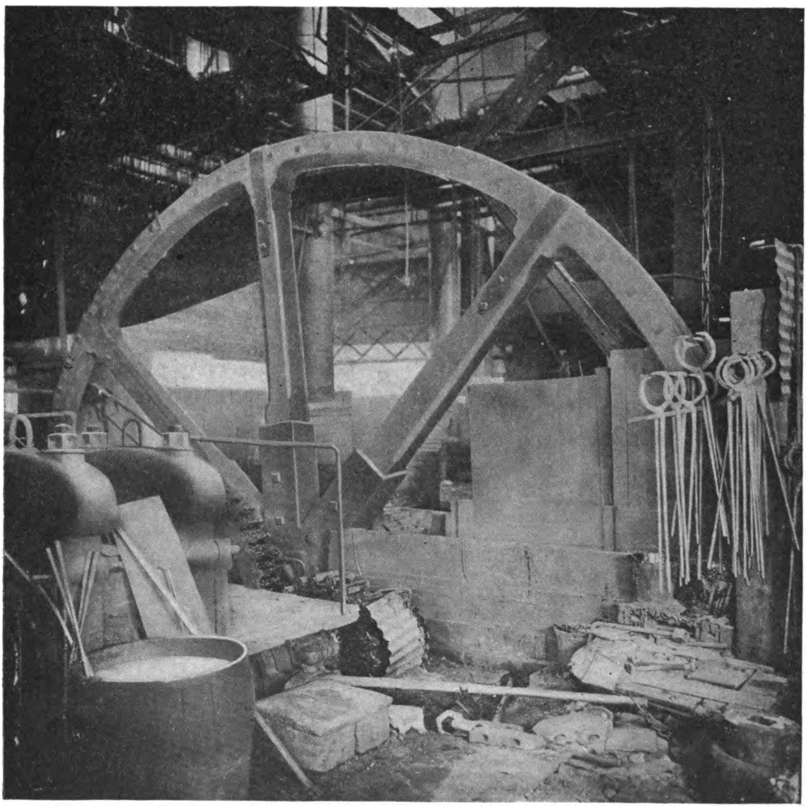
The Locomotive

of

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

Vol. XXIX. HARTFORD, CONN., APRIL, 1912. No. 2.



An Old Fly-Wheel.

Another Automatic Engine Bursts its Fly Wheel.

The illustration on the front cover of this issue of THE LOCOMOTIVE shows the wreck resulting from the failure, May 10, 1912, of a fly wheel on an engine of the high speed, simple, automatic type. The engine in question was a 12" x 12", center crank, and was belted to a generator at the Higginsville, Mo., electric light plant. This illustration is of particular interest, because of the wide-spread notion among engineers, that engines of the "automatic" shaft governed type cannot run away. A somewhat similar instance was recorded in THE LOCOMOTIVE for April, 1911.

It would appear that in this case the governor pulley failed first, and we are told that fragments went through the roof with considerable violence. This failure may have been hastened by a blow delivered to the rim of the wheel by the governor weight. When relieved of the first wheel, the engine seems to have slewed around on its foundation, fouling the other pulley on the sub-base, and shearing its spokes free from both the hub and the rim. This rotation of the whole engine is in the right direction (left handed), to be explained by the principles of gyroscopic motion. If we consider the crank shaft balanced for weight by the two wheels, when running normally, it would become immediately unbalanced by the failure of one of them. This failure would probably occur at high speed, and so is favorable to such an assumption. It is of course well known to those who have experimented with the simple gyroscopic tops of their school days, that if the wheel is spinning, the top may

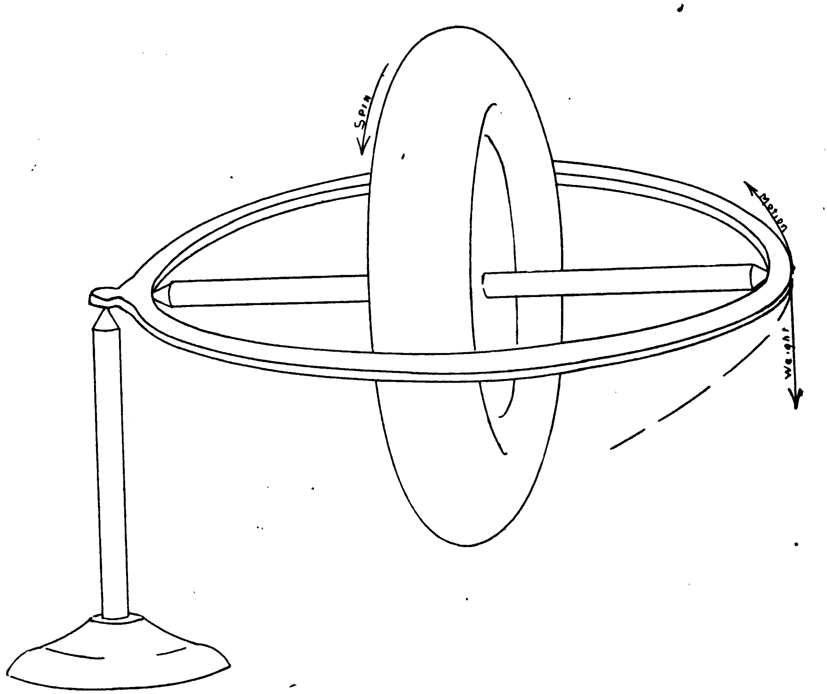


FIG. 2. SIMPLE GYROSCOPE.

be held at a point on the rim of the stationary ring, where it is unbalanced for weight, and in this position, instead of falling under the force of gravity, it rotates about a vertical axis, with a speed which depends on that of the wheel, and which will be greater, the heavier the top, or the more it is out of gravity balance. This appears to have been the behavior of the engine. Fig. 2, in which the directions of rotation correspond to those in the engine, will perhaps make clear our point of view.

A Disastrous Locomotive Boiler Explosion

The boiler of Locomotive No. 704 of the Southern Pacific Ry. Company exploded Monday, March 18, 1912, at 8:55 A. M., in the yards attached to the railway shops at San Antonio, Texas. This locomotive had been in the shops for repairs from February 12th to March 18th, and was being prepared for its initial run when the explosion occurred, but was still in the hands of the hostlers, inspectors, and shop men.

From the report of Chief Inspector Ensign of the Interstate Commerce Commission, as printed in "Power," the following facts and conclusions are abstracted, together with the results of tests on the sling stays made at the National Bureau of Standards.

The locomotive was of the heavy passenger 4-6-0 type, and was owned and operated by the Galveston, Harrisburg and San Antonio Ry. Co. It was built in March, 1908, by the American Locomotive Company at the Brooks Works. The firebox was of three-piece construction, crown bar type. The working steam pressure was 200 lbs. per square inch. The barrel of the boiler was made of ¾-in. steel, in three sections or courses, constructed with butt longitudinal joints having diamond shaped welts. The dome was located on the third course. The wrapper sheet was of ⅝-in. steel, the back head sheet and back flue sheet ½-in. steel, and the firebox door sheet, crown and side sheets, ⅜-in. steel. The firebox was stayed with rigid bolts ⅞-in. diameter at the ends, reducing to ¾-in. at the center of the bolts; four rows of Tate flexible bolts at the top of the firebox and two rows at each end, staggered at the top corners. The crown bolts were of a driving fit with countersunk heads 1⅛-in. diameter at the bottom end, and 1 in. diameter at the top end, extending through the crown bars with nuts on the top. The crown sheet was supported with 15 crown bars hung from the wrapper sheet by 168 sling stays, ⅝x3 in. and 12 sling stays 1½x 2¾ in. The flues numbering 355, were of 2-in. diameter. The boiler was equipped with three 3-in. Crosby safety valves.

The investigation brought out the following facts: During the time the locomotive was laid up, the following repairs were made to the boiler. Two hundred flues reset, one back head brace repaired, one front flue sheet brace and two throat stays repaired, eighty staybolts renewed, safety valves ground in, steam gauge tested, and hydrostatic pressure of 250 lbs. per square inch applied. Repairs were completed about 5:45 p. m. March 17th, and the locomotive fired up but no steam was raised. It was again fired up at about 6:10 a. m., on March 18th, and the safety valves began to blow when the steam gauge registered 50 lbs. pressure, at about 7:30 a. m. The safety valves were screwed down and again opened at about 8:00 a. m. The locomotive had a heavy forced oil fire from 8:00 to 8:55 a. m., at which time the explosion occurred.

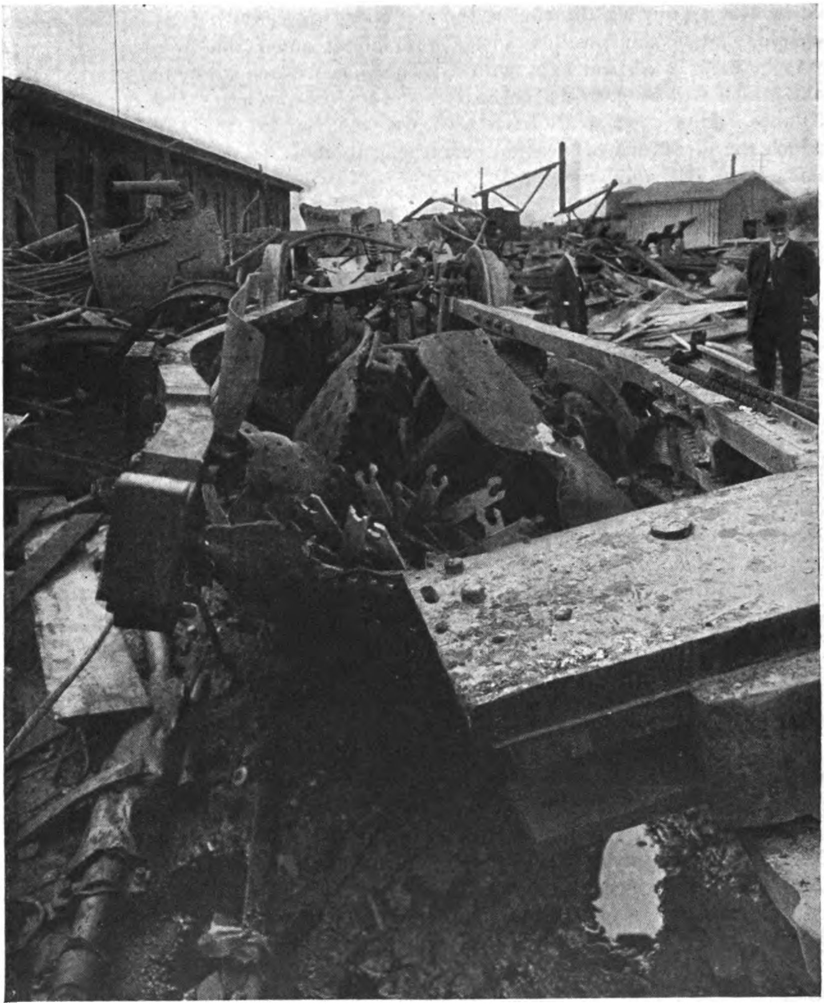


FIG. 1. SHOWING BROKEN SLING STAYS.

An employee of the railroad company, was engaged in setting the safety valves at the time of the explosion. The valves themselves could not be tested after the explosion owing to the damaged condition of the disks and springs, but the casings, with the adjusting screws and lock nuts were found and proved to be valuable pieces of evidence in unraveling the causes of the explosion. On one of the adjusting screws, the lock nuts were missing, another screw was bent, and the end burred over, and on all of them there was evidence that the corners of the hexagon heads had been rounded over in an attempt to tighten them, which resulted apparently in the subsequent application of a Stilson wrench in an attempt to further tighten the springs.

The steam gauge was shown to have been tested but there was no evidence to show that the siphon or connections were tested or known to be free from obstruction, and indeed, the government inspector found that on another locomotive of similar type, at the same shops, there were two valves between the gauge and the boiler, which when opened had their handles, one at right angles, and one parallel to the pipe. This arrangement was so confusing and unsafe that one of them was ordered removed.

Reference to Figure 1 will show the general character of the explosion which resulted in the immediate death of 26 men and we are informed, in the subsequent death of three more, making a total of 29. It will be noted that the explosion apparently started in the firebox, which was blown directly down. The front head with many of the tubes attached will be seen to have been projected forward and to the right, while the wrapper sheet and part of the third course, carrying the dome, were blown backward some three blocks and were said by observers to have attained a considerable height, estimated to have been some 500 feet. These sheets, weighing some 6,000 lbs. landed in a dooryard and are shown in Figure 2. A glance at Figure 3 will show at once the terrific character of the explosion, and also the fact that the damage was much greater at the rear end of the locomotive than at the forward end, as one of the after drivers is seen to have been completely forced from the axle.

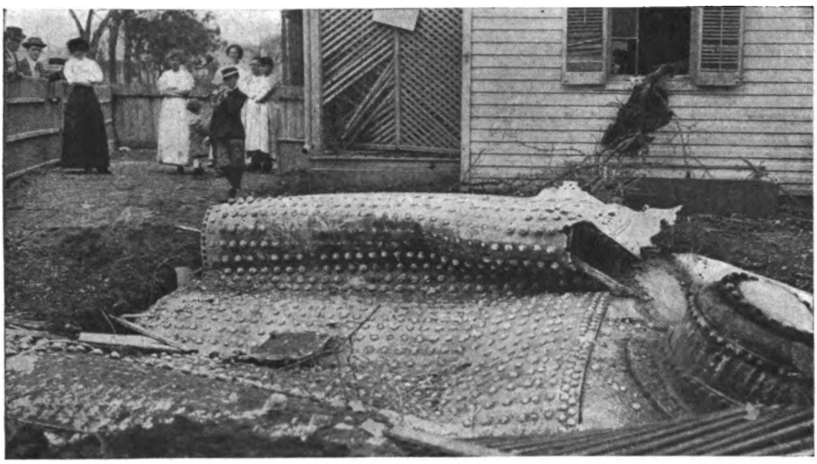


Fig. 2. Wrapper Sheet and Dome in Door Yard.

The crown bar sling stays were shown on examination to have been made of wrought iron, where the specifications called for steel. It was further shown that five 1-in. bolts had been used to attach the sling stays to the crown bars and also to the wrapper sheet, where the specifications on the drawing had required 1¼-in. bolts. The crown bars were not supported on the side sheets as is customary in this type of boilers, therefore the whole strain was carried by the sling stays. It was further shown that the sling stays failed by stretching out the eyes, which were much reduced in section. This can be clearly seen by reference to Figure 1, and would seem to indicate that the stays

failed by a gradual application of stress far in excess of that which they could safely carry.

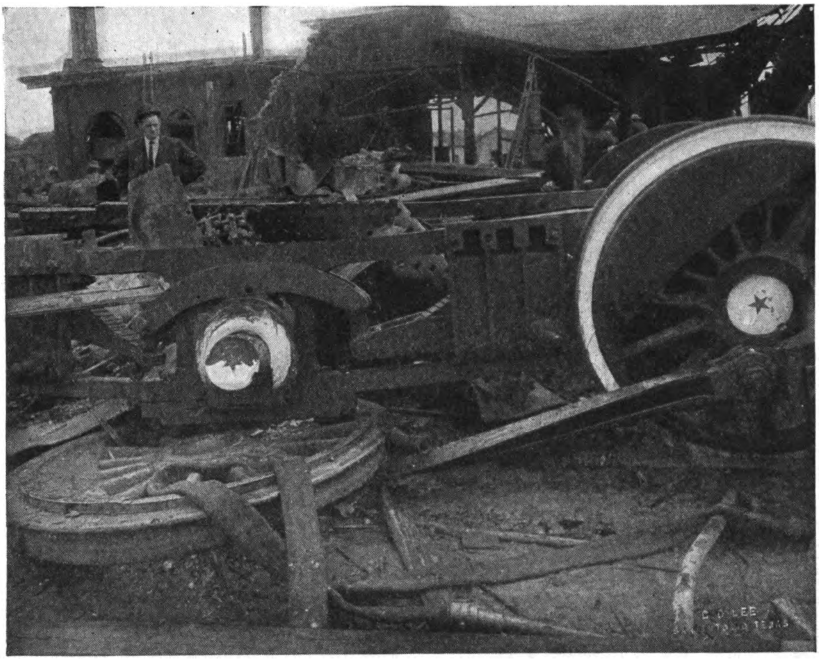


FIG. 3. DRIVER BLOWN FROM AXLE.

Five crown bar sling stays from this locomotive were tested by the United States Bureau of Standards to determine the load the stays would support when 1in. and 1¼-in. bolts were used. The bolts used were some taken from this boiler at the time of the explosion. Stays numbered 1 and 2, using 1-in. bolts, failed at total loads of 26,650, and 21,840 lbs. respectively, yielding for the lower value, a factor of safety based on the net section of only 2.67 while the higher figure would give a factor of safety of 3.26. Stays numbered 3, 4, and 5 broke at total loads of 30,000, 33,890, and 31,620 lbs. respectively. The 1¼-in. bolts were used with these specimens, and showed factors of safety varying from 3.67 to 4.15. The tensile strength of the material in the sling stays was found to be 43,200 to 48,300 lbs. per square inch, and the elongation from 18 to 40.5% in 2 inches. These tests are taken to indicate that the stays were drilled too near the ends.

The investigating inspector finds that the cause of the explosion was excessive pressure, due probably to a defective gauge, and the attempted setting of the safety valves by men of insufficient experience. He censures the railroad company severely for permitting such men to handle work of this character. He also finds that the local inspector had sworn to a report of the setting of the safety valves and the testing of the steam gauge on the day before, although

it was clearly shown that the actual work of setting the safety valves was in progress at the time of the explosion. He finds further that the railroad company was negligent in keeping a boiler in service whose factor of safety as shown by test was far below the limits generally set in such cases.

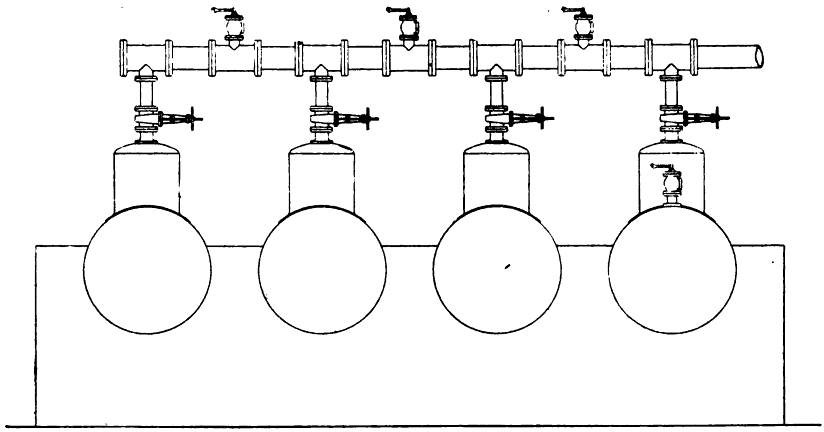
We understand from press accounts, that the Galveston, Harrisburg, and San Antonio railway company have made a public statement since the finding of the government inspector, in which they give the report of their own investigating board. This consisted of the following gentlemen: Col. Charles H. Clark, U. S. A., ordnance department; Capt. George A. Schreiner, U. S. A.; Lt. R. C. Burleson, U. S. A., expert on high explosives; J. H. Holmgren, president of the Alamo Iron Works, San Antonio, Tex.; G. W. Taylor, superintendent of motive power, S. A. & A. P. railway; W. B. Tuttle, manager, San Antonio street railway; Daniel Cleary, locomotive boiler inspector, S. A. & A. P. railway; A. M. Fischer, druggist, San Antonio, Tex.; F. McArdle, road foreman of engines, S. A. & A. P. railway; and T. H. Mooney, former master mechanic, G. H. & S. A. railway. This board differed widely in their conclusions. Four declared themselves of the belief that the wreck was due to overpressure. Two considered low water to have been the cause, followed in their estimation, by the pumping of cold water upon a hot crown sheet. One of the army officers expressed the opinion that "it is evident that the explosion was caused by some unusual, and extraordinary cause." All agree however, that the inspector of the Interstate Commerce Commission was at fault, in censuring the railway company as to the incompetence of its employees. We can understand something of the feelings of these gentlemen, especially as the accident occurred during a strike when rumors of dynamite and violence were prevalent, nevertheless, the photographs at hand, and the report of the tests made at the Standards Bureau, seem to give ample confirmation to the views of Inspector Ensign.

There seems to have been no member of the railway company's board who had a realization of the fact that a boiler full of water, when hot and under a considerable steam pressure, constitutes in itself, a high explosive of no mean order. These gentlemen base their arguments against over pressure, apparently upon the fact that the injectors were said to have been working just previous to the explosion, and refer to a statement of the makers, that about 240 lbs. is the limit at which this type of injector will continue to throw water into a boiler. They fail to realize, it seems, that a boiler with its safety valve "gagged," and with a heavy fire such as this locomotive is shown to have had, can accumulate a dangerous pressure with great rapidity, the time in this case, of course, being less than might have been expected on account of the weakness of the furnace sling stays, when used with one inch bolts.

A Dangerous Installation of Safety Valves.

The accompanying sketch of a steam pipe arrangement may be of interest as indicating the extreme of ignorance or carelessness in the installation of devices which are vitally necessary to the safety of a steam plant.

Our company had covered the boilers of this mill by a policy of insurance which expired in the latter part of 1911, and which we failed to renew because, as the assured stated, they had received much lower rates from a competitor.



UNSAFE ARRANGEMENT OF STEAM PIPES.

Sometime later the manager of the plant, meeting one of our inspectors, told him that he was not altogether satisfied with a rearrangement of piping which had been made, although he himself was not sufficiently expert in such matters to point out the defects. He made the request that our inspector visit the plant to advise him. Our inspector did so and found that since our coverage two boilers had been added and the steam piping remodeled in the manner shown by our sketch and that this had been done without remonstrance or criticism on the part of our competitor's inspector.

It is needless to add that when the absolute danger of the arrangement was pointed out, the management of the plant insisted that the competing policy be immediately canceled and that such premium be paid as was necessary to secure HARTFORD insurance and HARTFORD inspection service.

Furnace in Scotch Boiler Fails From Overheating.

The illustrations printed herewith show a dry back Scotch boiler after removal from the Dredge "Thor," one of the largest gold mining dredges on the Pacific Coast, used near Oroville, Cal.

The boiler is 8 ft. 2 in. in diameter, and 13 ft. long. The shell is of ¾-in. steel with the longitudinal joints of the triple riveted double butt strap type. The heads are ⅝ in. thick. The boiler is fitted with 128-3 inch tubes, and with a Morrison suspension furnace, 50 inches in diameter, and 13 feet long. The original thickness of the furnace plate was $\frac{9}{16}$ in., but a measurement obtained by drilling at a point 4 in. from the end after the collapse, showed the actual thickness to be $\frac{17}{32}$ in.

We are told that the ordinary working pressure was 135 lbs. and that this was about the pressure on the boiler at the time of the failure. Oil was used as fuel.

The failure which occurred on March 18, 1912, consisted in a flattening of the furnace, the top going down about 28 in. and the bottom coming up about 22 in., till the sheets met, forming a sort of figure 8 turned on its side, as may

be seen by reference to Fig. 2. The front head was pulled in, so that a number of the tubes above the furnace, projected through the sheet, from ¾ to 1½ in. and of course resulted in severe leakage.

After the accident, the oil burner was turned off and the steam used up in propelling the dredger to the bank, getting its buckets on shore, and hauling the water and oil barges alongside, some twenty minutes being consumed in the operation. No one was injured.

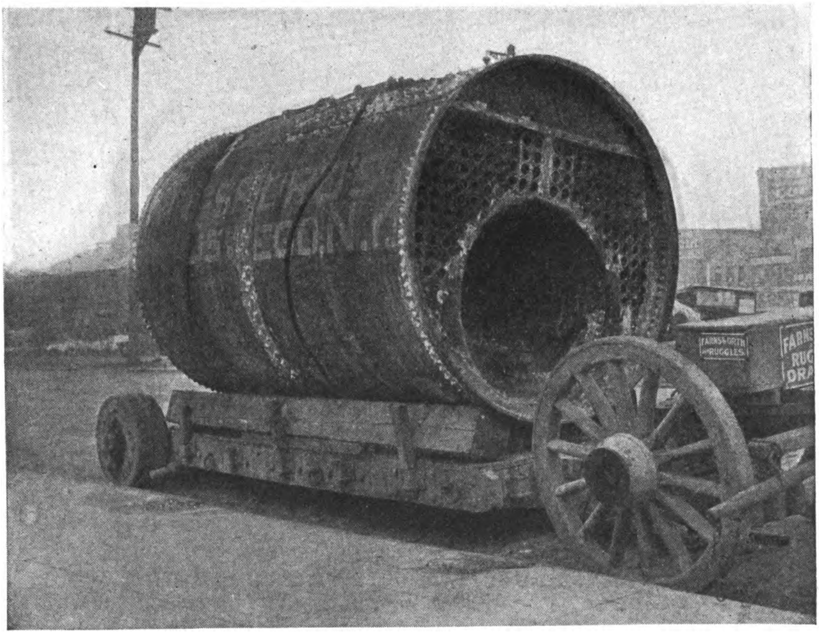


FIG. 1. BOILER OF THE "THOR."

The boiler was removed and shipped to San Francisco, with the idea of putting in a new furnace, and making other necessary repairs. It was found, however, on inspection that the boiler was so distorted as to make this impossible. It was also found that the tubes and furnace were so heavily coated with oil as to indicate that the cause of the failure was due to the furnace sheet becoming overheated, a very frequent cause of trouble when such oil films are allowed to collect on the inside surface of those parts of a boiler directly exposed to the action of the fire. The dredger was operated condensing and apparently no effort was made to prevent the oil used in the cylinders for lubrication, from entering the boiler with the feed water.

It would seem that this case is one of those preventable accidents which need not have occurred if the boiler had received regular and thorough internal inspections, as it is difficult to believe that a competent inspector could have failed to detect this particular trouble long before it reached the danger point. We understand that the boiler was comparatively new. No insurance was carried.

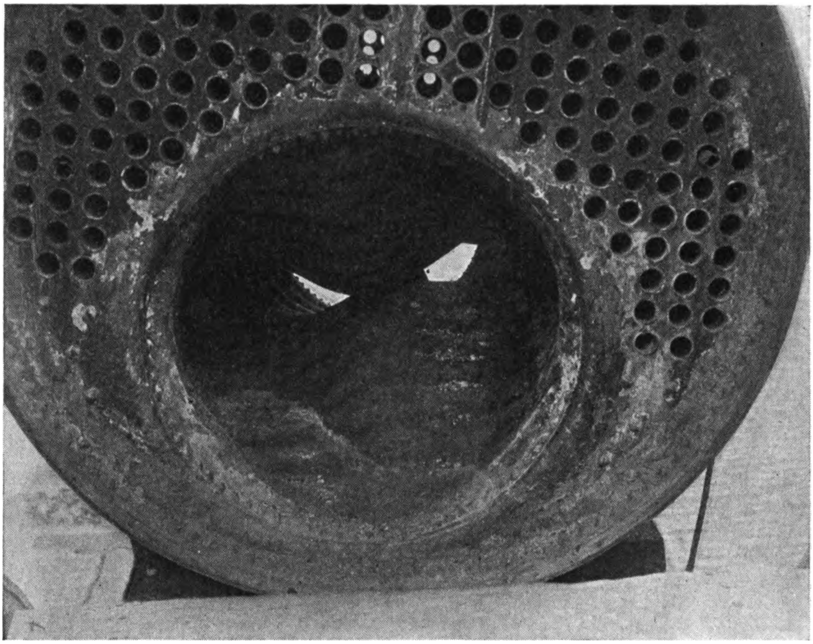


FIG. 2. THE COLLAPSED FURNACE.

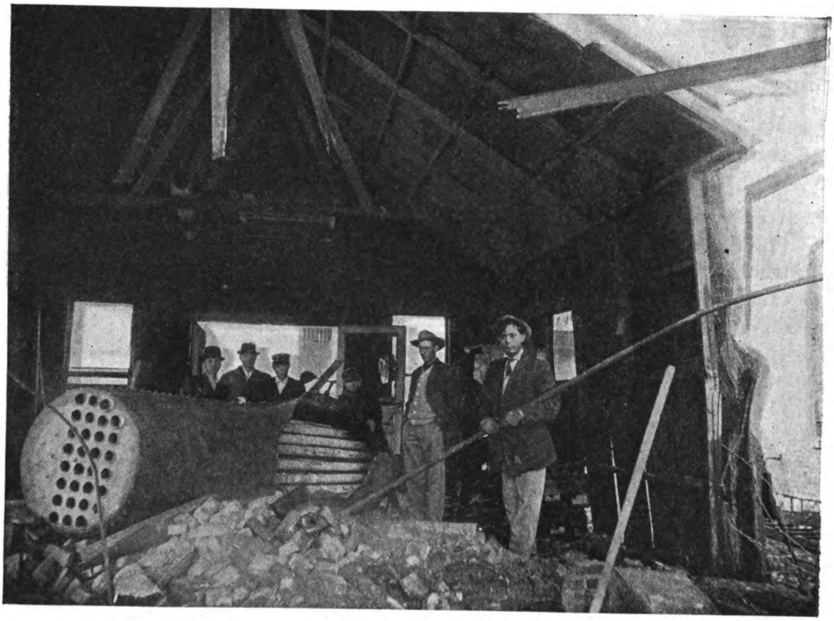
Locking the Door After the Horse is Stolen.

W. B. WARNER, Special Agent.

The accompanying illustration shows the condition of a boiler and premises, after an explosion which occurred recently, the location of which we do not mention for obvious reasons.

Our "Special" had solicited the insurance on this boiler periodically for several years, and at each visit had been given various excuses by the owner for not taking insurance. A few weeks ago the "Special" was again in the district, and having in mind this boiler and its owner as a possible prospect, made a stop on the chance that he would have better luck this time, as we feel that every uninsured boiler is a prospect, and that sometime we will get it.

When within a hundred miles of this place, he was advised of the explosion, and when he arrived at the town, he concluded to go over and see how serious the accident was, and incidentally, to speak of the folly of procrastination in matters of boiler insurance. As our "Special" approached the place, Mr. Owner spied him some fifty yards from it, and greeted him thus: "Hello Mr. ———, why the d—— didn't you make me insure my boiler the last time you were here?" "I did everything legitimate," replied the "Special," "to induce you to do so, and I thought I would come over and learn what new excuse you had to offer this time." "Well," said the owner, "my boiler blew up about two



THE BOILER WHICH DID NOT NEED INSURANCE.

weeks ago, and I am just getting this one ready to use. I am ready for the insurance now. I wish I had taken it before."

We now have a policy covering this plant, and if a similar accident occurs, it is our loss.

Boiler Explosions.

MARCH, 1912.

(138.) — The boiler of Locomotive No. 669 of the Philadelphia and Reading Railroad, attached to a through freight, exploded outside the station at Muncy, Pa., at about 9.30 p. m., March 1. Engineer William Fink, Fireman William Meyers, Conductor Boulton Whitenight, and Brakeman Harry Robinson, were killed. One man was injured.

(139.) — On March 2, a boiler in the factory building, at 794 Tenth Ave., New York City, exploded, during a fire which completely wrecked the building. Deputy Fire Chief Binns, and several firemen were in the boiler room just previous to the explosion and were injured seriously.

(140.) —A tube in a water tube boiler ruptured March 2, at the Allentown Portland Cement Co.'s plant, Allentown, Pa.

(141.) — On March 3, two tubes ruptured at the plant of the Fox Paper Co., Lockland, O., killing Frank Brunkamp and Ernest Williams. This was the second case of tube failure at this plant within a week. (See item 137 in the February list.)

(142.) — On March 3, a tube ruptured in a water tube boiler at the plant of the Illinois Steel Co., South Chicago, Ill. Geo. Novak and Alec Simon were injured.

(143.) —An accident occurred March 3, at A. Lisner's department store, the "Palais Royal," Washington, D. C. Considerable damage was done to the boiler.

(144.) —A tube failed March 6, at the Commerce St. power house of the street railway company, Milwaukee, Wis. Two men were badly scalded.

(145.) —March 7, the boiler at a stone crusher used in connection with the construction of a dam at Hamilton, Ill., exploded.

(146.) —A boiler exploded March 7, at the toy, and umbrella handle factory of Gilpin Bros., Greentown, Pa.

(147.) — The drum of a water tube boiler ruptured March 9 at the plant of the Sharon Tin Plate Co., Sharon, Pa.

(148.) — On March 9, a tube ruptured in a water tube boiler at the Ehret Magnesia Mfg. Co., Valley Forge, Pa.

(149.) — On March 9, boiler failed at the plant of the St. John Wood Working Co., Stamford, Conn. The damage was small.

(150.) —About March 9, the boiler in the old school building at Sellersville exploded.

(151.) —An accident to the boiler of the torpedo boat destroyer, U. S. S. Paul Jones, at San Diego, Cal., March 9, caused the death of Albert Grau, fireman, and the serious injury of Peter Wiera, fireman, and John J. Eberlein, coal passer.

(152.) — The boiler at the Belle Springs Creamery, Abilene, Kans., exploded on the morning of March 9, slightly injuring engineer Smart.

(153.) —A tube ruptured March 10 in a water tube boiler at the plant of the Columbia Chemical Co., Barbertown, O. Considerable damage was done to the boiler. (See also item 168.)

(154.) — On March 11, three sections of a cast iron sectional heating boiler failed at the Hotel Princeton, owned by Chas. M. Randall, Boston, Mass.

(155.) —A boiler ruptured March 11, at the plant of the Anderson and Middleton Lumber Co., Aberdeen, Wash.

(156.) — The boiler in the crating mill of Asa Smiley, Jamestown, N. Y., exploded March 11, seriously injuring the proprietor, and inflicting minor injuries to one other. The entire plant was wrecked.

(157.) — March 12, the principal building of the Columbus Contractors' Supply Co. at Taylors Station, near Columbus, O., was destroyed by fire following the explosion of the boiler. The loss was estimated at $60,000.

(158.) — The heating boiler in the home of Louis Muhs, Minot, N. D., exploded, March 12, fatally injuring Mr. Muhs, who was firing the boiler at the time.

(159.) — On March 13, the furnace of a vertical boiler ruptured on the Barge Canal Contract of Holler and Shepard, Ft. Edwards, N. Y.

(160.) — On March 15, a tube ruptured in a water tube boiler at the Western Branch, National Home for Disabled Volunteer Soldiers, National Military Home, Kans.

(161.) —A blow off pipe ruptured March 15, at the Port Huron Gas Co., Port Huron, Mich. Joseph Brown, fireman, was somewhat injured.

(162.) — On March 16, the boiler at the plant of the Mills-Ellsworth Lumber Co., Pine Bluff, Ark., exploded, doing considerable damage to the plant. One man was slightly injured.

(163.) —A tube ruptured March 18 at the plant of the Illinois Glass Co., Alton, Ill. One man was slightly injured.

(164.) —A locomotive boiler exploded in the yards of the Southern Pacific Railroad, at San Antonio, Tex., March 18. Twenty-five men were killed, four injured fatally, and many minor injuries inflicted. The damage to property was great.

(165.) — The internal furnace in a Scotch marine boiler collapsed March 18, on the gold mining dredge "Thor," near Oroville, Cal. No one was injured, but the boiler was so distorted as to be a total loss.

(166.) — On March 19, a boiler ruptured in the office building belonging to the estate of Thomas McGraw, Detroit, Mich.

(167.) — The boiler of a logging engine exploded March 20 at the saw mill of Jeams Bros., Rockland, Tex. Jesse Patrick and Lewis Furguson were fatally burned, and Jack Best, engineer, was slightly burned.

(168.) —A tube ruptured March 20 at the plant of the Columbia Chemical Co., Barbertown, O. This was the second accident within a month. (See also item 153.)

(169.) — The boiler of a locomotive attached to a coal train on the N. & W. R. R. exploded March 20, near Blue Ridge Springs, Va. One man, John W. Hunter, engineer, was killed, and two were injured, one fatally.

(170.) — On March 22, a wash-out plug blew out on a locomotive at the round house, Carthage, N. Y. The engine was under steam, and a workman was attempting to tighten the plug. He was fatally scalded.

(171.) — Five men were scalded, none fatally, when the boiler at the mine of the Turner Coal Co., Evans City, Pa., exploded March 23.

(172.) — On March 23, the boiler at the Cramer Creamery, Camden, N. J., exploded. No one was hurt, and the damage was confined to the boiler.

(173.) — On March 25 the boiler of a well drilling machine belonging to Denny & Cypher, Contractors, exploded at the Melarky farm near Marwood, Pa. No one was injured.

(174.) —A tube ruptured in a water tube boiler at the plant of the Victor Talking Machine Co., Camden, N. J., on March 25.

(175.) —A saw mill boiler owned by Stewart and Hardin, at Holcomb, Miss., exploded March 25, killing four men and injuring three more, one fatally.

(176.) —A boiler exploded March 26, at the McCormick Works of the International Harvester Co., Western Ave. and Thirty-first St., Chicago, Ill. Six were injured,. one of whom died soon after the accident.

(178.) — On March 26, a boiler exploded at the saw mill of H. L. Hearn, Salisbury, Md. Five men were instantly killed and three more injured.

(179.) — On March 27, one man was slightly burned by the explosion of a boiler at the City power house, Wellington, Kans.

(180.) —A blow-off pipe failed March 25, at the Fall River Iron Works, Fall River, Mass. Antone Casmere, fireman, was scalded.

(181.) — The boiler of an engine used to run a circular saw at the farm of H. H. Peterson, Whiting, Ia., exploded March 27, killing one man, and injuring four others, one seriously.

(182.) —A Delaware and Hudson locomotive exploded March 29, near East Worcester, N. Y., killing Howard Wickham, engineer, and Jacob Houck, fireman. Three others were injured, one seriously.

(183.) — Two cast iron headers fractured March 30, in a water tube boiler at the plant of the American Laundry Co., Mobile, Ala.

(184.) — On March 30, the boiler of a locomotive exploded near Tuscola, Ill., on the Cincinnati, Hamilton and Dayton R. R. Alva Friddle, brakeman, was killed, and three others injured.

April, 1912.

(185.) — On April 1st, a plate ruptured in a boiler at the Connors-Weyman Steel Co., Helena, Ala.

(186.) — A blow-off pipe ruptured April 2, at the plant of the Southeastern Yaryan Naval Stores Co., Brunswick, Ga.

(187.) — About April 2, two boilers exploded on David Hoover's saw mill operation, near Saxton, Pa.

(188.) — A heating boiler exploded in the high school building, Pewaukee, Wis., on April 28, just after the close of the session. No one was injured.

(189.) — On April 28, the boiler at the mill of the Ida H. mine, near Belle Center, Ill. Two men were seriously injured, a small dog is said to have been killed.

(190.) — A boiler in the cant hook factory of C. A. and M. E. Wellman, at South Boardman, Mich., exploded April 5. One man was killed, and five others injured, one perhaps fatally.

(191.) — On April 4, a locomotive belonging to the Southern Pacific R. R. exploded near Rice Hill, Ore. M. M. Bartlett, engineer, and Bert Anderson, fireman, were killed.

(192.) — A boiler at the plant of the Salisbury Ice Co., Salisbury, Md., exploded April 5. One man was killed, one fatally injured, and several others were slightly injured.

(193.) — On April 6, an accident occurred to the boiler at the Painted Post, N. Y., plant of the Ingersoll-Rand Co. Considerable damage was done to the boiler.

(194.) — On April 8, Solomon Burke was killed as the result of a boiler explosion at the saw mill of W. M. Walker, Linden, N. C.

(195.) — The explosion of a locomotive boiler on the Southern Pacific, at Stanwix Station, Ariz., April 9, resulted in the death of C. C. Vaughn, engineer, and the fatal injury of B. E. Norton, fireman.

(196.) — On April 9, a heating boiler in the Turkish Baths at 120-122 Ridge St., New York City, exploded, fatally scalding two persons.

(197.) — On April 10, the boiler at the mill of the Orillia Lumber Co., Orillia, Wash., failed, injuring three men, one fatally.

(198.) — A tube ruptured April 10, at the plant of the Virginia Portland Cement Co., Fordwick, Pa. John A. Harris, fireman, was injured.

(199.) — A cast iron header ruptured April 10, in a water tube boiler at the mill of the American Steel and Wire Co., Waukegan, Ill.

(200.) — A blow-off pipe failed at the Moxie Co's plant, New York City, on April 12.

(201.) — On April 12, a stop valve on the main steam line ruptured at the Western Branch, National Home for Disabled Volunteer Soldiers, National Military Home, Kans. John Ockerman, helper, was killed.

(202.) — A boiler ruptured April 13, at the plant of the Union Dairy Co., Rockford, Ill. The damage was small.

(203.) — On April 15, a boiler used for well drilling at New Martinsville, W. Va., exploded, killing Thos. S. McNight, a tool dresser, and injuring one other.

(204.) — On April 16, the crown sheet of a locomotive portable boiler pulled off the stay bolts at the Holran Stone Company's quarry, Maple Grove, O.

(205.) — On April 16, as the result of a boiler accident at the plant of the Pacific Coast Steel Co., South San Francisco, Cal., one man was fatally injured.

(206.) — A boiler exploded April 17, at an oil well near Cannonsburg, Pa. One man was injured, and will probably die.

(207.) — On April 17, a boiler exploded at a fertilizer plant near Seven Stars, Pa. One man was slightly injured.

(208.) — The boiler at the plant of the Powell River Milling Co. exploded April 19. Leonard Swanson and Henry Hollingsworth were killed, and some six others injured, one fatally.

(209.) — On April 19, a boiler failed at Newbill's saw mill, Lebanon, Pa. Three men were killed and three injured, one fatally.

(210.) — A tube ruptured April 19, in a water tube boiler, at the Donora, Pa., plant of the American Steel and Wire Co. Considerable damage was done to the boiler.

(211.) — A copper cooker failed April 20, at the Fleishmann yeast plant, Cincinnati, O. One man was killed and five were injured, two fatally.

(212.) — An Illinois Central locomotive boiler exploded in the yards at Bloomington, Ill., April 21. Weaver Hillerman, engineer, was killed and Orville Clay, fireman, seriously injured.

(213.) — A boiler ruptured April 22, at the plant of the Flower City Tissue Mills Co., Greece, N. Y. The damage was slight.

(214.) — On April 22, the boiler of a Western Pacific locomotive exploded near Elko, Nev., killing three trainmen.

(215.) — The boiler at the Butterfield saw mill, Kelso, Wash., exploded April 23. Three men were scalded, and property damaged to the extent of about $1,000.

(216.) — A tube failed April 25, in the basement of the Rike-Kumler store, Dayton, O. Two men were injured.

(217.) — On April 25, a tube failed in a boiler at the power house of the Sheboygan Railway and Electric Co., Sheboygan, Wis. Two men were slightly injured.

(218.) — On April 25, a tube ruptured in a water tube boiler at the Pickands Mather Co's furnace, Toledo, O. One man was injured.

(219.) — A tube ruptured on April 26, at the power house of the Metropolitan St. Ry. Co., Central Ave. and Water St., Kansas City, Kans.

(220.) — On April 27, the crown sheet of a locomotive collapsed on the main line of the Union Railroad Co., Port Perry, Pa. W. H. Watkins and W. F. Wesser, engineers, were injured.

(221.) — A plate failed in a boiler at a paper box factory, Thomas and Cambridge Sts., Milwaukee, Wis., on April 28. One man was scalded.

(222.) — A tube ruptured April 30, in a water tube boiler at the power plant of the Mobile Electric Co., Mobile, Ala. The damage was small.

(223.) — Several cast iron headers fractured April 31, at the plant of the Quaker Lace Co., Philadelphia, Pa.

MAY, 1912.

(224.) — On May 1, the furnace of a Scotch marine boiler collapsed at the plant of the National Biscuit Co., 409 Liberty St., Pittsburgh, Pa. The damage to the boiler was considerable.

(225.) — The heating boiler at Public School No. 1, Long Island City, N. Y., exploded May 2. Over 1600 school children were marched out of the building in less than three minutes, no one was injured.

(226.) — A heating boiler exploded May 3, in a residence at Ridley Park, Chester, Pa. One man was injured.

(227.) — On May 3, two concave heads in the steam drum of a water tube boiler collapsed, at the plant of the Ohio Iron and Steel Co., Lowellville, O..

(228.) — A tube ruptured May 5, in a water tube boiler, at the plant of the Tri-State Railway and Electric Co., East Liverpool, O. Clyde Jones, fireman, was injured.

(229.) — On May 5, the boiler of the launch Orin B., used by the Atlantic Gulf and Pacific Co., on the barge canal works near Glen Falls, N. Y., exploded. Charles Grilse, engineer, was killed and George H. Terry, injured.

(230.) — The boiler of a threshing machine exploded May 6, on the farm of Otto Drake, Dundee, Mich. Two men were killed.

(231.) — On May 6, the flanging of a vulcanizer failed at the plant of the Boston Woven Hose and Rubber Co., Cambridge, Mass.

(232.) — A tube ruptured May 6, in a water tube boiler, at the Diamond Crystal Salt Co., St. Clair, Mich.

(233.) — A water heater exploded May 6, in Hanscomb's restaurant, So. Ninth St., Philadelphia, Pa. The loss was estimated at $5,000.

(234.) — A tube ruptured May 9, at the rolling mill of Moorehead Bros. and Co., Sharpesburg, Pa. Considerable damage was done to the boiler, and Wick Velump, fireman, was injured.

(235.) — On May 11, a boiler at the Landingville knitting mill, Landingville, Pa., exploded. Harry Warmkessel, fireman was scalded.

(236.) — A tube ruptured May 12, in a water tube boiler at the plant of the Kenosha Gas and Electric Co., Kenosha, Wis.

(237.) — On May 15, a boiler failed at the Duquesne Steel Foundry, Kendall Station, Pa. The damage was confined to the boiler.

(238.) — A vulcanizer exploded May 16, at the Empire Rubber Co's plant, Trenton, N. J., killing one man, and fatally injuring two more.

(239.) — A blow-off pipe failed May 16, at the Lessing Apartments, owned by Chas. E. Rector and T. J. Tucker, Chicago, Ill. Chas. O'Conner, engineer, was slightly injured.

(240.) — On May 18, a flue in a dryer collapsed at the Kansas City, Kans. plant of the Swartzchild & Sultzburger Co. The damage was confined to the vessel itself.

(241.) — The boiler exploded May 18, at the saw mill of John de Frain, near Brownback's Church, Pa. Charles Smith and Chester Herzog were killed, and three others injured.

(242.) — On May 21, a steam pipe burst on the steamer James E. Davidson, in Lake Superior. Eight men were scalded, two fatally.

(243.) — A saw mill boiler exploded May 24, at Farina, Ill. One man died as the result of injuries received.

(244.) — The boiler of a well drilling machine exploded May 24, on the property of F. Marion Vanderveer, North Branch, N. J. Two men were injured.

(245.) — A tube ruptured May 25, in a water tube boiler at the blast furnace of the Upson Nut Co., Cleveland, O.

(246.) — On May 25, a flue failed in a boiler at the power house of the Wheeling Traction Co., Wheeling, W. Va. Charles Grubb was injured.

(247.) — A cast iron header failed May 30, in a water tube boiler at the plant of the Diamond Alkali Co., Fairport, O. No other damage is reported.

(248.) — On May 31, a boiler ruptured at the plant of the Dallas Portland Cement Co. The damage was small.

Fly Wheel Explosions.

(To Complete the 1911 List.)

(57.)— On September 16 an automobile fly wheel burst at the corner of Pico and Howard Streets, Los Angeles, Cal. One man was severely injured.

(58.)— A fly wheel at the plant of the Pittsburg Brewing Co., Connellsville, Pa., failed September 21, doing damage to property to the extent of $5,000.

(59.)— The fly wheel at the Transit Shoe Company's plant, Franklin, Pa., exploded October 9. One man was injured.

(60.)— October — a fly wheel burst at the plant of the United States Handle & Cooperage Co., Malden, Mo. Two men were killed and two others injured.

(61.)— On October 24 a fly wheel at the plant of the Hagerty Shoe Company, Washington Court House, Ohio, exploded, doing considerable property damage. (See Power for November 14, 1911.)

(62.)— On December 2 Harry Waldron was killed at the plant of the Standard Motor Construction Co. by the bursting of a gasolene engine's fly wheel. The engine was being prepared for installation in a motor boat.

(63.)— The fly wheel attached to an air compressor at the Ready Bullion Mine, Treadwell, Alaska, exploded about December 13. The compressor and building were demolished, and several hundred men thrown out of employment temporarily.

Fly Wheel Explosions, 1912.

(1.)— A fly wheel attached to a pumping engine used in connection with the construction of a sewer at Richmond Hill, N. Y., exploded January 1. One man received a broken arm as the result of the accident.

(2.)— On January 21 a large fly wheel failed at the plant of The Fox Paper Co., Lockland, Ohio. Oscar Cummins, an oiler, was attracted to the engine by the breaking of the main belt. The engine attained a dangerous

speed, and he was killed by the bursting fly wheel while trying to close the throttle.

(3.)—The fly wheel attached to a deep well drilling machine exploded January 25 at the yards of the Paris Coal and Ice Co., Paris, Tenn. Will Dowe, engineer, received injuries which resulted in the loss of an arm.

(4.)—A fly wheel at the mill of the Friend Paper Co., West Carrolton, Ohio, exploded January 26. No one was injured, but the mill was closed one day as the result of the accident.

(5.)—On February 17 a fly wheel attached to the engine at the shingle mill of the Humbolt Manufacturing Co., Arcata, Cal., burst. Property was damaged to the extent of about $500, and one man, a saw filer, was killed.

(6.)—A wooden fly wheel at the saw mill of Triplett and McCann, Lost Camp, Mo., exploded April 17, killing John Triplett, one of the proprietors.

(7.)—On April 24 a fly wheel in the Westchester Lighting Company's power plant, Yonkers, N. Y., exploded. There was some property damage, but no one injured.

(8.)—The bursting of a fly wheel on April 28, at the plant of the Atha Tool Co., Newark, N. J., inflicted slight injuries to one man.

(9.)—On May 1 a 12-foot pulley burst in the dynamo room at the paper mill of Dill and Collins, Philadelphia, Pa. Property damage to the extent of from $3,000 to $4,000 resulted, principally through the rupture of a steam line, and the pipes of the sprinkler system by flying portions of the wheel.

(10.)—The fly wheel of an engine at the Higginsville, Mo., electric light plant failed May 13, doing property damage to the extent of about $3,000. (See front page of this number of THE LOCOMOTIVE.)

(11.)—On May 22 a fly wheel at the brick yard of Nevill Bros. and Mink, Llanwellyn, Pa., exploded, resulting in damage to the plant estimated at $1,500.

(12.)—A fly wheel attached to the engine at the Louisiana and Arkansas R. R. shops, Stamps, Ark., exploded June 4. The loss is thought to be under $1,000.

(13.)—On June 7 a pulley burst at the Rittersville Electrical Works, Allentown, Pa. One man was injured.

(14.)—A fourteen-foot fly wheel burst June 7 at the Phœnix Cement Works, Nazareth, Pa. The damages are estimated at $3,000.

(15.)—On June 10 the fly wheel of an engine at the East Jordan (Mich.) Electric Light and Power Co. burst, killing A. Z. Wilcox, the engineer, and damaging the plant to such an extent as to leave the town in darkness for a week.

(16.)—A fly wheel exploded June 11 at the power plant of the D. & H. R. R., Green Island, N. Y. The plant was damaged to the extent of $1,000.

A Narrow Escape.

W. J. SMITH, Inspector.

The opportunity of witnessing a "real live" lap seam crack in action is seldom afforded boiler operators. This unique and rather undesirable experience was recently afforded several employees of The Anderson-Middleton Company, Aberdeen, Washington. The fireman, desiring to operate a valve

in a steam line over the boilers, was attracted by the issuance of steam from the insulating material on top of the boiler. Removing this covering, the steam and water were seen to spurt from a crack about ten inches long, the edges of which vibrated under the pressure.

The Chief Engineer being called, with great presence of mind instead of shutting off the engines and turbines, which might have produced a shock or increase of pressure, immediately banked the fires, closed the draft and opened the feed water valves. In this manner the pressure was soon reduced to less than forty pounds. The main stop valve was then shut off. The boiler, being one of three fired in battery, a division wall was built in the furnace and the day following the other boilers were in operation.

The defective portions were cut out of the boiler and revealed a crack one eighth of an inch from the edge of the inner lap, and about 5 ft. 6 in. long, no portion of which was visible from the inside.

The boiler was about seven years old, had been operated at its designed working pressure and had frequent and careful supervision with good care and management.

It is needless to say there is considerable congratulation going the rounds among those interested, for aside from the probable heavy loss of life, the boiler was part of a very expensive plant and surrounded on all sides by high grade machinery and equipment.

We wish to commend the coolness and good judgment of the chief engineer, and firemen of this plant. This type of boiler defect is undoubtedly one of the most treacherous of the many possible causes for boiler explosions, as it too often reveals itself only after the property is destroyed.

Instead of stopping his engines, this chief had the good sense and nerve to cover his fires, and control his steam by using it up, thus saving not only the company's property, but perhaps many lives as well. EDITOR.

A "Mexican" for a Safety Valve.

We record on another page of this issue, an instance of safety valves being so erroneously installed as to become objects of danger, by the possibility of their leading to a feeling of false security, but it remains for the following, extracted from one of our inspection reports, to cap the climax, as a display of ignorance of the vital importance of this particular boiler accessory. We give the extract verbatim.

"Engineer (?) of above plant explained that his reason for removing the safety valve from boiler was that it leaked, and that he thought as long as he had a Mexican watch the steam and not let it get too high, that the boiler was safe. He stated further, that he had a perfectly good ash pit door, and that by closing it the steam would go no higher. I tried to make it plain to all concerned, that Mexicans, and ash pit doors, would not answer in any way the purpose of a safety valve." (The inspector found that the safety valve had been replaced with a solid plug.)

The Locomotive
of
THE HARTFORD STEAM BOILER
INSPECTION AND INSURANCE CO.

C. C. PERRY, EDITOR.

HARTFORD, JULY, 1912.

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THE LOCOMOTIVE OF THE HARTFORD STEAM BOILER I. & I. CO.

On another page we print a news item and editorial comment from the *Hartford Courant* announcing the reinsurance of the boiler and fly-wheel business of The Casualty Company of America by THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY. Of course we are gratified at this event for many reasons, but perhaps especially because of the confidence in us which is thus signified by the management of so prominent an institution as the Casualty Company. Obligations to its assured required that the service which supplanted its own should be above criticism, and self interest demanded that its reinsurance should be placed only with a company of high financial standing. We accordingly feel a pardonable pride in the recognition of our standing implied by this selection and expressed by President DeLeon of the Casualty Company in his announcement of the change to his agents as follows:

"I need not call to your attention the standing and reputation of The Hartford Steam Boiler Company throughout the United States, or to the splendid service rendered by that company to its policy holders everywhere, which has made the Hartford company pre-eminently the *leading boiler insurance company of America.*"

Appreciation like that from a one-time warm competitor is a compliment indeed. We shall endeavor to justify it by a service to the boiler and fly-wheel owners whom President DeLeon has entrusted to us which will force their endorsement of his opinion. We welcome them all to the HARTFORD STEAM BOILER fold.

The Casualty Company of America has been one of the four larger multiple-line casualty underwriters in the boiler and fly-wheel field. In 1911 according to its official statement it wrote $117,594 in premiums of these two lines, and of this amount $108,229 was for boiler insurance. There were in 1911 twenty-four casualty companies competing with the HARTFORD in steam boiler underwriting. The total of premiums written by them was $1,101,922, an average

of about $46,000 per company. The Casualty Company of America, writing more than twice as much business as its average multiple-line competitor, and exceeding all but three of those competitors in the volume of that business, would seem to have had a favorable position in the field. If it has become discouraged with the prospects and financial returns from such business what bright future can allure the twenty smaller companies?

The truth is that steam boiler insurance,— and this applies to fly-wheel insurance also — is peculiar and distinct from other lines of underwriting in that to experience a normal loss ratio a technical supervision of the apparatus covered is necessary. It is obvious that the expense of such a service must be proportionately greater with a company which insures a small number of widely scattered boilers than with one whose business is so great as to justify a broad distribution of inspection centers from which all its assured may be economically reached. To make the small boiler business successful, the company writing it must either be content with little or no profits, or it must charge more for its protection than its large competitor, or it must reduce the character and frequency of its inspection service at the risk of a higher loss ratio, more accidents, and the consequent annoyance and dissatisfaction of its assured.

The HARTFORD STEAM BOILER with a business of $1,300.000 annually and with over 100,000 boilers under its care, has been able to establish a standard of service which steam users generally have come to appreciate. It has been deriving from its business an average underwriting profit less than 9%. This is certainly a moderate return for the energy expended and the risks carried. Is it likely that an insurance company would be content with less? If not it follows that the small boiler underwriter must charge more for its protection or reduce the character of it. The public is too well posted to pay to others a larger premium than will purchase HARTFORD insurance, nor will it long permit a character or lack of inspection service which risks disastrous explosions. The result is the dilemma of the kind in which the Casualty Company of America found itself and which it has solved in the manner announced.

A correspondent sends us a newspaper clipping descriptive of the action of a New York tug captain in attempting after a collision to run his boat ashore before the water leaking in could reach the boilers "and cause an explosion". With it he writes that this "and numerous articles in relation to the 'Titanic' and other sinking ships leads me to ask you if there is any foundation whatsoever for the newspaper theory that boilers in sinking steamships explode because of being plunged into cold water".

We agree with the view of this gentleman as further expressed that the theory is not tenable and that even should a boiler under such circumstances fail locally the force of the explosion would be slight owing to the almost instantaneous condensation of the steam when submerged in the cold water. We admit that we have not ourselves been on a sinking steamship, but our company has had opportunity of examining boilers which have passed through that ordeal, and others which because of a fire have had cold water poured upon them. The evidence thus available would indicate that not always at least does submerging cause a boiler explosion, and further we do not see why it should.

It may be stated without fear of contradiction, that a boiler explodes because it is incapable of withstanding the internal pressure exerted in it. The disaster may be caused either by an abnormal increase in the pressure or by an equally abnormal decrease in the strength of the boiler material. Now, so far as we can see, none of the conditions necessary to an increase in pressure would be produced by submerging in water a boiler under steam. Such a treatment would naturally reduce the temperature and consequently the pressure very promptly. The treatment could have little effect, either, on the strength of a vessel made up of steel plate although it is probable that local contraction strains would be produced by a gradual rather than sudden submergence. The steel used in boilers is not usually a brittle material and withstands sudden and violent changes in temperature without cracking. Failing to discern among the conditions which attend the submerging of a boiler anything which would increase the pressure or decrease its strength and being to an extent backed by the slight experience already suggested, we will — pending evidence to the contrary — continue in the belief that a boiler explosion is not a necessary circumstance in the sinking of a ship.

It may be added that the tug captain first mentioned did not according to the clipping succeed in "beaching" his boat before it sank, and if in sinking the boilers exploded, the effect was too insignificant for the reporter to record.

Announcement.

Hartford, Conn., July 1, 1912.

In the January number of The Locomotive our Company announced with regret the resignation of the editor who had so ably conducted this paper for a number of years. Since then we have been seeking a man to fill the place thus made vacant and from a number under consideration have selected Mr. Clarence C. Perry, who commences his editorial duties with this issue.

We feel that Mr. Perry is especially equipped by his experience and education for a work which requires both a theoretical and practical knowledge of steam and allied engineering practices and also a wide acquaintance with the literature of those subjects. He is a graduate of The Sheffield Scientific School of Yale University, class of 1904, and since then as a member of the faculty of that institution has been instructing the students of the Department of Electrical Engineering in physics and steam engineering subjects. While in this position Mr. Perry was frequently called in consultation where expert advice on steam matters was desired and thus was brought in intimate contact with the practical problems of installation and operation.

I take pleasure in this opportunity of introducing Mr. Perry to those of our own organization who have not met him personally, as well as to our assured and other readers, and express my conviction that under his management our paper will continue in its position of authority and interest among technical periodicals.

Lyman B. Brainerd, *President.*

Obituary.

Sylvester W. Higgins, special agent for the Hartford Steam Boiler Inspection and Insurance Co., at Detroit, Mich., died May 7 at his home, 120 Euclid

Ave., in that city. His death came as the culmination of an illness of several months duration.

Mr. Higgins was born in Utica, N. Y., in 1834, but removed to Detroit with his family at an early age. The family were prominent both in the city and state, being associated closely with church work in Detroit. His father was at one time State Geologist of Michigan.

Mr. Higgins had been the Detroit representative of the Hartford Steam Boiler Inspection and Insurance for some twenty years, and his sterling qualities won for him the esteem and respect of all his business associates.

He is survived by a widow and three daughters, Frances E. and Ethel M. of Detroit, and Mrs. R. R. Strong of Pueblo, Col.

Personal.

Mr. Joseph H. McNeil, who, since 1898, has been connected with the boiler inspection service of the State of Massachusetts, first as inspector, and later as chief inspector, and chairman of the Board of Boiler Rules, tendered his resignation, to take effect July 8th, in order that he might accept the position of chief inspector in the Boston Department of THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY.

Mr. McNeil's experience has been both wide and varied, and is of such a nature as to fit him most admirably for the position he now enters with the HARTFORD. Born at Charlottetown, Prince Edward Island, in 1865, he was educated in the public schools, and Prince of Wales College. His experience has included railway work, both mechanical and executive, with the Prince Edward Island Railway and the various phases of stationary and marine engineering. He has held the position of chief engineer of ocean going vessels, under licenses, both from the United States government and from the British Board of Trade. Of his work for Massachusetts, it is perhaps only necessary to say that the well-known boiler inspection law of that state owes much of its success, if not its very existence, to his judgment, tact, and executive ability.

Chief Inspector Frank S. Allen, who has had charge of both the Boston and Hartford departments, will by this appointment be relieved of the detailed supervision of the large number of boilers in the former district. He will continue in immediate charge of the inspection service handled from Hartford, and will be able to devote his attention to the general inspection problems of the Home Office to a greater extent even than in the past.

The Boiler and Fly Wheel Insurance of The Casualty Co. of America Taken Over By the HARTFORD.

[From The Hartford (Conn.) Courant June 28, 1912.]

The Hartford Steam Boiler Inspection & Insurance Company has taken over and reinsured all of the steam boiler and fly wheel business of the Casualty Company of America of New York City.

The Casualty Company of America was organized and commenced business in September, 1903, as a multiple line company, and it has gradually built up and developed the numerous casualty lines to an extent that its aggregate net premium receipts last year exceeded $2,500,000. From the insurance commissioner's report of 1912, it would appear that it is one of the stronger and more progressive companies, having a paid up cash capital of $750,000, a net surplus over all liabilities exceeding $205,000, and total assets exceeding $2,801,000.

As relating particularly to the steam boiler line, the Casualty Company of America ranks as the fourth or fifth company in point of volume, its steam boiler premiums written last year exceeded $108,000, and the volume of business taken over by the Hartford Steam Boiler Insurance Company exceeds 12,500 boilers and about $100,000,000 of insurance liability. This is undoubtedly the largest transaction that has ever taken place in this particular line of insurance.

From an interview with President Brainerd of the Hartford Steam Boiler Insurance Company it was learned that conditions pertaining to the steam boiler line are in a very unsettled and unsatisfactory condition, and that competition is very keen. He further said that as the steam boiler line was so limited in volume as to render it impossible for any one company to develop and greatly expand it, in view of the fierceness of competition and the great cost of maintaining an inspection service, such as is now demanded by the insuring public and in many instances required by law, the management of the Casualty Company of America had reached the decision that the resources of the company and the time and energy of its officers could be better and more profitably employed in developing and building up its other and more prominent and more promising lines of insurance.

It appears that the total amount paid last year for steam boiler insurance throughout the United States amounted to but $2,303,104, and that of this amount $1,275,103 was paid to the Hartford company, notwithstanding there were no less than twenty-five companies competing for this small volume of business. It was further explained that because of the peculiar character of steam boiler and fly wheel insurance, their distinctive feature being the maintenance of an efficient inspection service, they are two of the most limited and most expensive lines to conduct of all the numerous casualty lines, and that unless a considerable volume can be controlled in each state throughout the Union, an efficient inspection service cannot be maintained with any promise of profit, in view of the expenses in maintaining an organization and an inspection service as today required, if the business is to be properly conducted.

It will at once be observed that if the premiums paid for steam boiler insurance should gradually become equally apportioned between all the companies at this time competing for it (and all things being equal, and each company maintaining an equal and as extended an organization and efficient inspection service, there is no reason why this condition should not obtain), there would be an

average of less than $100,000 annually that it would be possible for any one company to secure, and that this sum would be barely sufficient to maintain one inspector in each state throughout the Union.

The Hartford Steam Boiler Inspection & Insurance Company was organized and commenced business in 1866, and on January 1 last its paid-up capital was $1,000,000, its net surplus over all liabilities exceeded $1,801,000, and its assets amounted to $5,045,874.60. It makes a specialty of steam boiler and fly wheel insurance and conducts no other class or kind of insurance.

This is the seventh instance in which the Hartford Steam Boiler Company has taken over the steam boiler line of other companies.

EDITORIAL COMMENT.

It is an important announcement that President Brainerd of the Hartford Steam Boiler Inspection and Insurance Company makes this morning — the acquisition of the steam boiler business of the Casualty Company of America. The amount of reinsurance is said to equal about one-tenth of the Hartford company's present business. It is a substantial business deal, comprehending an original premium income of over $300,000.

The steam boiler insurance business has been conducted profitably in Hartford and many small companies have been formed to enter the field. These companies find that an adequate inspection service, such as the Hartford company maintains, is a great expense and one sure preventative of large profits. It would not be surprising, therefore, if other companies followed the Casualty Company's lead. The Hartford company can take over this insurance with very slight increase in its working force. It means more business for Hartford.

Boiler Tubes Undergo a Marked Loss of Ductility.

By a Chief Inspector.

In the examination of boilers and other vessels operated under steam pressure, the inspector often meets conditions which to him at least are unexpected and peculiar. But while they may be new to him, generally on conferring with other inspectors, he will learn of similar instances. The present incident, with its tests showing the nature of the trouble, may be of assistance to some one in clearing up such a difficulty.

The agent for a large manufacturing concern desired an examination of one of his boilers, which were of the water tube type, and all duplicates. They had been in service but a comparatively short time. He requested this inspection not because of any trouble, but on general principles, as several months had elapsed since the last regular examination. The writer responded to this request, finding one of the boilers properly prepared for inspection. No ordinary defects were found. The boiler was clean and free from scale in all its tubes and drums. The tubes were of full thickness, and under the hammer test not the slightest indication of anything defective was conveyed to the examiner. He noted however, a peculiar appearance to those tubes which were accessible, and directly exposed to the fire. Touched with a fine file the metal was bright,

and its appearance was perfectly normal. The unusual color of the tubes however disturbed him very much, and he requested that some of them be removed for testing; since while they might prove soft and ductile, he was of the opinion that they were dangerously brittle, and feared from the general arrangement of the fire room that loss of life would follow the failure of a tube at the high pressure carried. He held this view notwithstanding the fact that these boilers were designed with a good factor of safety for the pressure carried, for he considered the danger of personal injuries greater than that of a property loss. The mill agent took up the question of testing the tubes at once. The first blow struck with a chisel in cutting off one of them close to the drum, caused the tube to break. Every tube was then removed and test specimens one inch wide cut from each. All were found to be practically as brittle as the first, and showed an entire absence of ductility. It was felt that if they had been continued in service, a shock, or even the vibrations of the engine would have been sufficient to have fractured a tube, and the reaction might well have caused the breaking of several more.

Samples of four of these tubes were sent for chemical analysis, the result of which is given in table 1.

Table 1.

	No. 1.	No. 2.	No. 3.	No. 4.
Carbon	.06%	.06%	.06%	.06%
Manganese	.02%	.02%	.02%	.02%
Phosphorus	.079%	.073%	.065%	.073%
Sulphur	.020%	.026%	.024%	.020%
Silicon	.154%	.159%	.143%	.154%

Compared with the requirements for fire box steel boiler plate the low percentage of carbon and manganese, with high phosphorus will be at once noted, and will indicate why the tubes were so deficient in ductility.

At about this same time, a similar change was found to have occurred in the tube cap bolts of another type of water tube boiler, from the same maker, but belonging to another firm. These bolts which were not exposed either to the direct action of the fire, or to so high a pressure as in the first case, were found by the inspector to be so brittle that on sounding them with his light hammer, many of them broke as if they had been glass rods. The chemical analysis of these bolts was very similar to that of the tubes mentioned above, though differing from it to a slight extent. The conclusion is obvious that the stock in both the tubes and bolts was of a very inferior quality and ought never to have been used in any place exposed to high temperatures or to strains due to pressure.

A new tube and several bolts from the same stock as those removed, were tested physically and showed good ductility, but analysis proved that the material was no better than that which had been rejected for its extreme brittleness.

It has long been a dream of the writer that all material used for boiler work should be plainly marked, the marks to be uniform with all manufacturers, and to indicate the quality of the material. These could be placed upon the head of a bolt in forging, at slight expense, and in welded tubes, could be made at the time of welding. Solid drawn tubes present of course, a slightly different prob-

lem, but that process itself would perhaps be a guarantee of a better quality of material than would be used for welding.

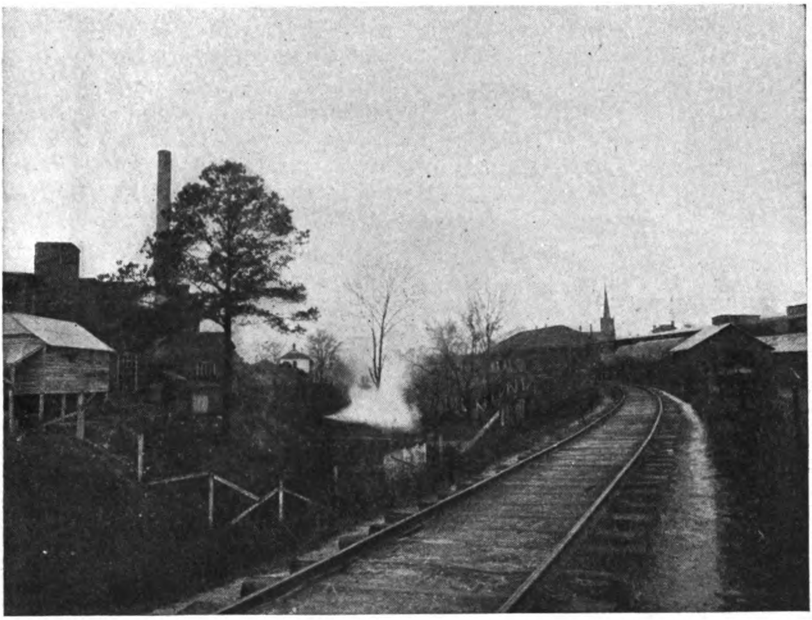

FIG. 1. THE OIL TANK, RAILROAD AND BOILER HOUSE.

An Alabama Mystery.

The accompanying photographs were sent us by a correspondent whose veracity we have no reason to doubt, in substantiation of the following most remarkable boiler accident. This mishap occurred to what was then the No. 2 boiler of the Eufaula Cotton Mill, Eufaula, Ala., early in 1897. This boiler is said to have discharged certain of its tubes bodily through the tube sheets, sending four of them out of a window, across a gulley and a railroad track, until they were intercepted by an oil tank which they pierced. The relative location of the track, gully, boilerhouse, and oil tank can be seen by reference to the photograph, Fig. 1, which shows the present appearance of this locality. A close scrutiny of Fig. 1 will show patches applied to the tank, and if one will turn to Fig. 2, which is a nearer view, one will see that they consist of a horseshoe, and three round patches, said to have been placed there in repairing the damage done by the flying tubes. A fifth tube missed the tank, but punctured the stack which occupied the site of that shown in Fig. 1, but has since been removed to a location such that it was impossible to obtain a photograph of it.

The accident happened early one Sunday morning, about 5 a. m., when no one except the watchman was about the plant. He was attracted by an unusual

noise in the direction of the boiler house, but the performance was over before he could reach the scene. The cause of this peculiar action was never satisfactorily explained, and remains one of the mysteries of our Atlanta Department.

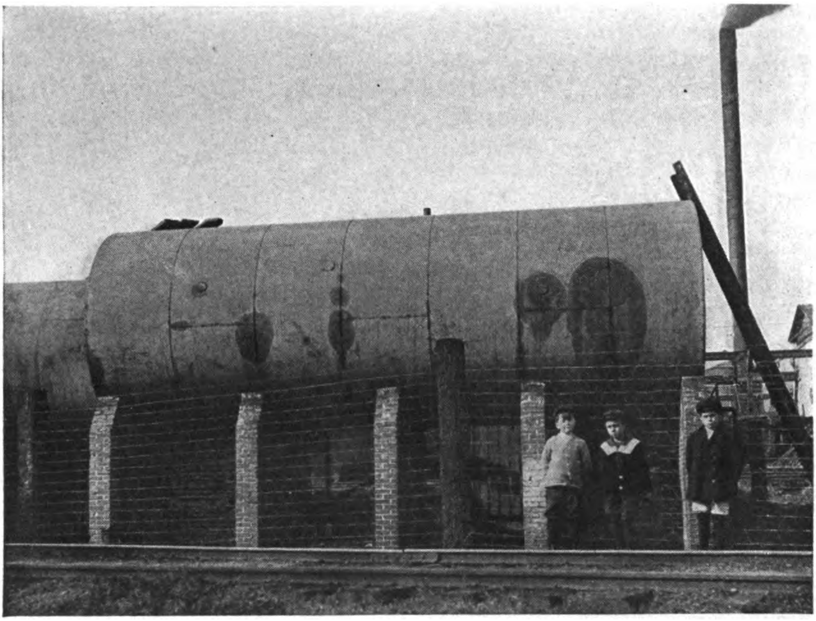

FIG. 2. THE PATCHED OIL TANK.

The boiler itself did not leave the setting, indeed it was not sufficiently disturbed to disconnect it from the steam pipe. Nine tubes left the boiler entirely, and seven or eight more were projected part way through the front head. Aside from slight repairs to the setting, the only work needed on the boiler was the replacing of these sixteen or seventeen tubes.

The question remains unanswered as to what made this boiler cut up this particular sort of caper, and if anyone can answer it, or cite a parallel case, we shall be very glad to hear from him.

Patching a Boiler Without Rivets, Bolts, or Welding.

E. J. ENOCH, *Inspector.*

Not long since a brother inspector, in reporting upon a patch applied to a boiler, remarked that "the job looked as though it had been done by a shoemaker."

The writer was recently sent to inspect a job of repair involving a patch, but as it was neither pegged, nailed or sewed, it could hardly be said to display the art of shoemaking, resembling more the handiwork of a bricklayer.

The patch in question was placed on the rear drum of a Hawley down draft furnace. This was attached to a horizontal tubular boiler which carried a working steam pressure of one hundred and twenty-five pounds. A crack had developed in the drum, starting at one of the tube holes in the upper row, near the center, and extending circumferentially to a point near the top, a length of about five inches. The boiler maker (?) who was called to make repairs prepared a patch of ⅜" plate, shaped like Fig. 1 to fit over the top of the drum, and down each side of the tube opposite the fracture. A liberal quantity of asbestos cement was spread over the crack, the patch placed over the cement, and the brick arch, or deflecting wall rebuilt on top of the patch to keep it in position.

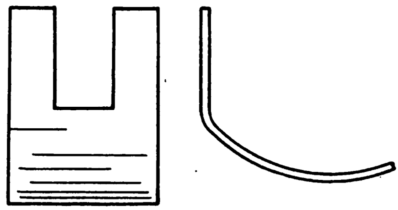

FIG. 1. THE PATCH.

It is not known what pressure was attained after the repair was completed, as the attendant was kept so busy in a fruitless effort to maintain a fire in the furnace against the flow of water from the fracture, that he failed to note the reading of the pressure gage. Nevertheless the patch was not blown out of the furnace, and the greatest damage was to the purse of the mill owner.

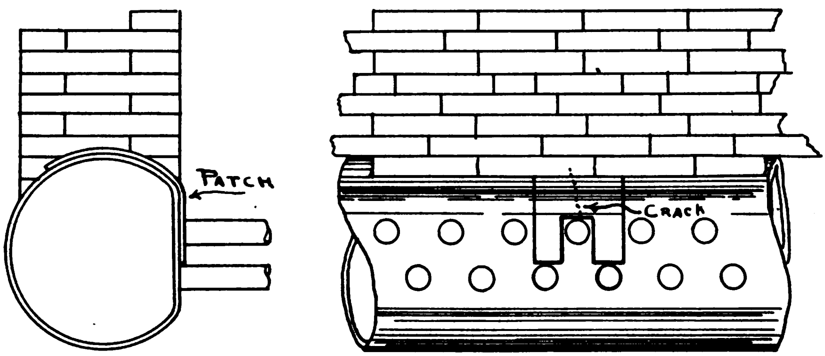

FIG. 2. PATCH BRICKED AND CEMENTED IN PLACE.

Queer Cause for an Erratic Steam Gage.

By INSPECTOR J. J. MCCURRY.

One of our inspectors relates the following incident relative to an incorrect steam gage, and the queer cause which he found for its lack of truthfulness.

He was called to a plant to make a test as the gages were not reading together. There were two gages in the boiler room, one on each of two Stirling boilers, and one, a recording gage, in the engine room. On removing the gage from boiler No. 1, it was found to be 5 lbs. "slow", but on resetting, and replacing it, it agreed perfectly with the recording gage. The other gage on the No. 2 boiler was then found to be 12½ lbs. ahead of the one just reset, and it

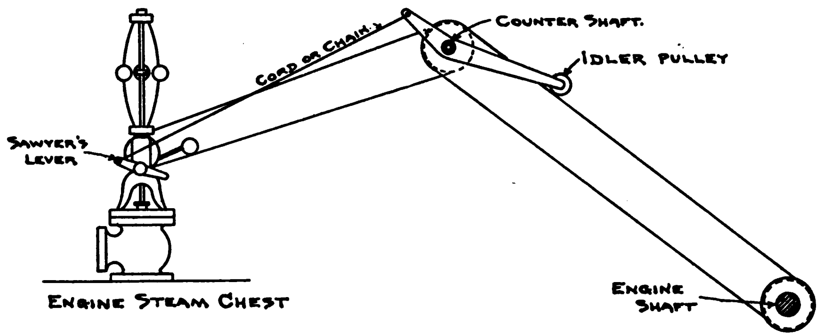

FIG. 1.— SAFETY DEVICE FOR A COUNTERSHAFT DRIVEN GOVERNOR.

When it is necessary to use two belts, as noted above, it is evident that the automatic safety stop on the governor will not operate if the belt that runs from the engine shaft to the counter-shaft should break. In this case, the governor would stop revolving and drop to its lowest position, allowing full steam admission to the cylinder, which would result in the engine racing. To obviate this danger, a second idler pulley similar to the one attached to the governor should be provided to operate on the belt leading from the engine to the counter-shaft, as shown in the accompanying sketch. This can be fitted with very little trouble or expense by the engineer or other mechanic about the plant, as the outfit only consists of the pulley and arm with cord or chain to attach to the Sawyer's lever on the governor, which also operates the safety stop. When thus connected, the governor can then be relied upon to stop the engine if either of the belts break.

Governors of this type are not always fitted with Sawyer's valve levers; but in nearly every case a point can be found where an attachment can be made which will produce the desired result.

Reuben, Reuben, I've bin thinkin'
  What a glad world this will be
When them b'ilers cease their bustin'
  And get safe for you an' me.

Laws don't seem to make us keerful,
  Folks gits reckless jist ther same;
An' when we hev jined ther angels
  Jury sez we was to blame!

—*Power.*

The Hartford Steam Boiler Inspection and Insurance Company.

ABSTRACT OF STATEMENT, JANUARY 1, 1912.

Capital Stock, . . . $1,000,000.00.

ASSETS

Cash on hand and in course of transmission,		$204,693.25
Premiums in course of collection,		263,453.33
Real estate,		91,100.00
Loaned on bond and mortgage,		1,166,360.00
Stocks and bonds, market value,		3,249,216.00
Interest accrued,		71,052.02
Total Assets,		$5,045,874.60

LIABILITIES.

Premium Reserve,		$2,042,218.21
Losses unadjusted,		102,472.53
Commissions and brokerage,		52,690.67
Other liabilities (taxes accrued, etc.),		47,191.65
Capital Stock,	$1,000,000.00	
Surplus over all liabilities,	1,801,301.54	
Surplus as regards Policy-holders,	**$2,801,301.54**	2,801,301.54
Total Liabilities,		$5,045,874.60

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L. F. MIDDLEBROOK, Assistant Secretary.
W. R. C. CORSON, Assistant Secretary.

S. F. JETER, Supervising Inspector.
E. J. MURPHY, M. E., Consulting Engineer.
F. M. FITCH, Auditor.

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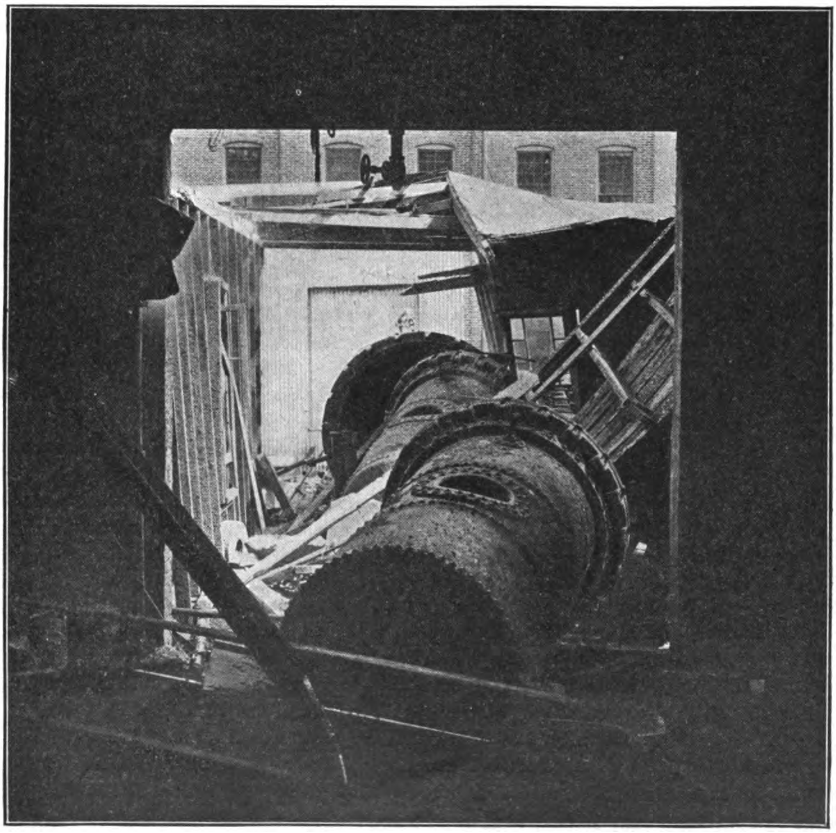
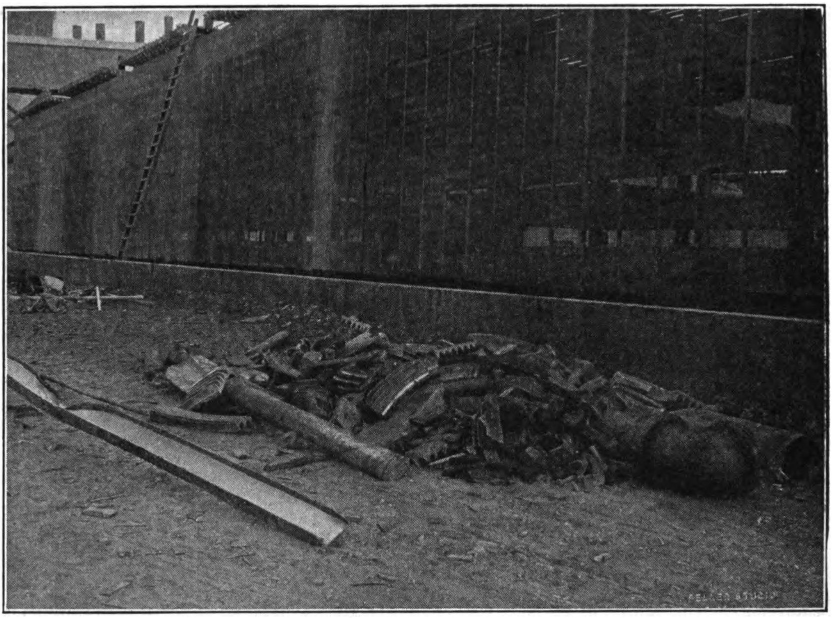
The Locomotive
of
THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

VOL. XXIX. HARTFORD, CONN., OCTOBER, 1912. No. 4.



A VULCANIZER EXPLOSION.



The Remains of the Fly-Wheel, Alpha, N. J.

Fly-Wheel Explosion at Alpha, N. J.

A fly-wheel attached to a 750 horse power cross compound condensing engine, of the shaft governed, or automatic type burst June 9, 1913, at the plant of the Alpha Portland Cement Co., Alpha, N. J. The fly-wheel or rather wheels, for two wheels were used side by side to secure a wide face with two sets of arms for the better distribution of the load in a rope drive, were cast in halves and joined at the rim by flanges bolted together. In addition the two wheels were bolted to each other at their rims. The engine beside having a shaft governor, was equipped with an independent over-speed stop of approved design and construction.

We are told that about 2 A. M. on June 9, the night engineer was attracted to this engine by something abnormal. Just exactly what happened is unknown though the engineer is said to have attempted to bring his engine to rest. The wheel exploded tearing holes through the roof and sides of the building, and wrecked the engine as the photographs show. Two men received fatal injuries, the night engineer and an oiler, the latter died almost instantly while the night engineer lived but a few hours. Both these men received their injuries from escaping steam.

The wreck presents very interesting complications when an attempt is made to reconstruct the circumstances which preceded the explosion. There is excellent evidence that the governor operated, as the weights were thrown so forcibly against the rim of the governor case as to make deep and obviously fresh

imprints in the crust of oil and cement dust with which it was lined. Moreover the over-speed stop appears to have operated, though whether it tripped automatically or was tripped by the engineer in an unsuccessful attempt to stop his engine is unknown.

It is known that the stop was tested and in good working order a few days before and the valve controlled by it was found closed after the accident. All this would seem to point to some agency disrupting the wheel during the beginning of a race which the control mechanism might have conquered if the wheel had remained intact. Perhaps the driven pulley failed first, then the engine relieved of its load would start to race. If in addition to this the fly-wheel was injured by fragments of the driven wheel it might have exploded at a speed far below that at which it should have failed if uninjured.

Here is another case of a destructive fly-wheel wreck on a shaft governed engine, fitted with a modern over-speed stop, and representing a typical installation of the sort popularly supposed to be outside the pale, so to speak, and quite immune to such a disaster. The present instance merely confirms the position we have taken so many times in THE LOCOMOTIVE, that no type of engine, no matter how well equipped, can be considered incapable of tremendous damage, when the necessary conditions for such an occurrence exists.

Fuel Economizers.

A fuel economizer may best be considered as an extension of the heating surface of a boiler, used so that the feed water may take up heat from the flue gases which would otherwise be wasted up the stack. This heat which the economizer transfers to the feed water is not always a total loss, as it furnishes of course, the motive power to drive the spent flue gases out of the stack when natural draft is used. Indeed, in many cases an economizer will so reduce the stack temperature that there is not enough of this motive power left to produce a satisfactory draft, and fans must be installed either to force cold air into the ash pits — forced draft — or to pull the flue gases through the furnace, boiler and economizer, expelling them up the stack — induced draft.

That there should be any economy in so reducing stack temperatures with an economizer that a fan becomes necessary for the production of a proper draft is due solely to the fact that a chimney is perhaps the poorest that is, the least efficient heat engine which is commonly used in engineering. To put the same statement in another way, a good steam engine or better yet, an electric motor, can produce a given draft for the expenditure of less heat than will be used to produce the same results at the furnace with a chimney It is the difference between the heat necessarily left in the flue gases to produce a stack draft, over that required in the form of steam energy or electric energy to drive the fan, which an economizer can save to do useful work in the power plant. It must be understood, however, that in both cases we are dealing with the available heat in the gases, that is, the heat which they can be made to give up by cooling them to the temperature at which the feed enters the boiler or, as a matter of fact, to a temperature as near that at which the feed enters the boiler as our economizer may be made to work, for all the heat energy left in the gases when

cooled to this temperature is no more available to do work for us than is the energy in the water of a mill race after it has fallen to a level below that of the draft tube from the water wheel.

In the form commonly used, an economizer consists of a bank of vertical tubes connected at top and bottom by suitable headers and placed in the flue between the boilers and the stack. The commonest arrangement places the tubes in rows of say ten, connected at top and bottom with a cross box to form a unit not unlike one section of a large steam radiator. These units are then stacked up — again somewhat like a radiator — and connected together top and bottom by headers placed lengthwise of the flue, with outlets to take the ends of the top and bottom cross boxes. As many units are connected together as are required to furnish the desired amount of heating surface. Of course, variations exist between the designs and methods of installation of the different makers, but there are certain features in common, and as it is the purpose of this article to treat economizers in general and not the product of any particular maker, these differences will be neglected. We do not believe there will be any difficulty in applying the suggestions we propose to any ordinary economizer.

The method of operation usually adopted is for the feed to enter at the stack or cool end of the bottom longitudinal header, whence it is permitted to circulate through the tubes and headers, becoming hotter as it passes along, until it finally leaves at the boiler or hot end of the top longitudinal header. In a few cases, economizers have been designed to permit of a circulation which is up through the tubes of one part and down through those of another, or even up in one tube and down in the next. While these special arrangements require a different arrangement of top and bottom connections, they need not be specially considered at this time.

The material ordinarily used in economizer construction is a high grade of close-grained cast iron. This material is necessary because whatever corrosive elements a water may contain are liberated, as a rule, by heating. Therefore, that part of a boiler or feed water heating system in which the water is first heated to a temperature approximating that of the boiler will suffer most severely. As is well known, cast iron is much less affected by the various forms of corrosion than wrought iron or steel, so that it is practically the only material which may be used for the purpose. It is of course true that steel feed water heaters are widely and successfully used, but there is this important difference between them and economizers, that the water in the latter is heated to temperatures far higher than those attained by ordinary feed water heaters. Indeed, temperatures up to 350° F. are not uncommon.

The construction usually adopted for attaching the tubes to the top and bottom cross headers is a pressed or friction joint. The tube ends are machined to a true tapered surface, given a fine finish and then pressed into corresponding tapered holes in the headers. The joints by which the cross headers are united to the type of longitudinal top and bottom connection which happens to be employed are either flange joints, bolted up and made tight with some form of gasket, or else of pressed construction similar to that described for the tube ends. The top headers are provided in practically all cases with openings opposite the tube ends, large enough for the removal of a tube when one must be

replaced. These openings also serve to gain access to the interior for cleaning and inspection. They are closed by internal covers having a tapered metal to metal joint, which are held tight by the internal pressure and pulled into place by some form of yoke and drawing bolt. One end of each top or bottom cross box is ordinarily closed, but the other end, where it is joined to the longitudinal connection, may usually be reached by some form of hand hole cap, secured by bolts, so that it may be opened for cleaning and inspection as well as the top ends of the tubes.

It has been found that the temperature or expansion strains at the junction between the longitudinal and cross headers are very severe if too many units are assembled rigidly together. To overcome this difficulty, it is customary to use sections of longitudinal header short enough to reduce the expansion strains to a safe value, and then these are connected end to end by "U" bends to give the desired flexibility, thus making one whole economizer of a number of little economizers connected in series.

The setting of an economizer is really an extension of the flue. It may be made of brick or steel, and must serve three purposes. First, it must furnish a satisfactory support for the economizer. Secondly, it must supply a tight path for the flue gases from the boiler to the stack, around the economizer tubes, so that excessive leaks may not dilute the hot gases, using up heat in raising the temperature of the leakage air which should go into the feed water. In the third place, the setting must act as a non-conducting shell to cut off as far as is practical losses by radiation. The setting must be so formed as to offer as little friction to the passage of the gases as is consistent with its other requirements, and to provide a pit into which the accumulations of soot may be scraped by the scrapers to be described later.

Whatever the type of construction adopted for the side walls of the setting, it is customary to make use of a layer of some insulating material such as asbestos or mineral wool as a roof over the top headers. To this end the top headers are generally so designed that when in place they make a continuous cover, touching each other and resting on the side walls at their ends, so that the addition of the non-conducting layer mentioned above is all that is necessary to make this setting roof conform to the conditions we have already outlined. Moreover, with the top headers covered in with an easily removed lagging, the top tube caps are readily reached for all purposes. If the sides of the setting are of steel, the usual arrangement consists of plates insulated with asbestos, and joined to each other by means of angle iron flanges, bolted together. Sometimes a combination setting is arranged, having a brick wall on one side with a sectional steel casing on the other, which gives greater accessibility than an all brick setting. In any case, clean-out doors to the soot pit are provided and access doors are fitted to the flue.

Mention has been made of the soot scraper gear. This consists of cast iron scrapers encircling each tube, arranged to be slowly moved up and down their full length, and ordinarily arranged to scrape on the up stroke. The scrapers on a group of neighboring tubes are fastened together in a frame and the whole frame is slowly pulled up and down by chains. Such a chain would pass up from one frame, over an upper sprocket wheel and down to a similar frame so spaced that when one frame is ascending the other is falling, reaching the ends of their strokes at the same time. In this way the driving gear is

relieved of the weight of the scraping mechanism, and is only called upon for the actual work of soot removal. The sprockets are driven by gearing through an automatic reversing clutch which trips at the end of each stroke. The drive can be obtained from any convenient motor, engine, or line shaft. It is important that the scrapers be kept continuously at work, for if they stop for any appreciable time a deposit of soot gathers on the tubes, which not only cuts down the efficiency of the apparatus, through retarded heat flow, but which is liable to bake on in the form of a hard cake or incrustation, stalling the scrapers when they are next set to work. To rid the lower part of the structure of soot as fast as it is removed by the scrapers, the lower cross boxes are made enough narrower than the top ones so that a good passage is left between each pair to the soot pit below. Soot pits are generally provided large enough to hold from one to two months' accumulation, and of course the length of the interval between successive clean outs must be governed by the rate at which coal is burned.

For safety and convenience in operation, an economizer must be fitted with various valves and attachments. The arrangement which we describe has been chosen after a good deal of study and thought, and while it may differ in some respects from the general practice, we feel that it is worthy of very serious consideration. A stop valve, and frequently a check valve, are provided at the economizer outlet to the feed line. In ordinary operation, the stop valve is unnecessary, *and should be locked open.* Its only purpose is to permit repairs to the check and for this use it should be placed between the check and the boiler.

A stop valve should be provided at the inlet end, so that the vessel may be isolated for inspection and repairs, the boilers being fed meanwhile by a by-pass line direct from the pump. This by-pass connection must never be opened when the gases are passing through the economizer casing. A case has come to our attention where an economizer in normal operation began to show an unusually high temperature on the thermometer inserted in the flue at the stack end. The engineer tested his safety valve, and found that steam issued instead of water. On looking over the valves and connections he found that the by-pass had been opened, but that all the other valves and the dampers were as for ordinary operation. The pump of course, forced the water to the boilers by the easiest path, which in this case was through the by-pass. The economizer, when the circulation through it was so reduced, acted as a steam generator, and like any other water tube boiler the upper portion filled with steam forcing some of the water out into the feed line.

Under such circumstances there is a danger due to the difference in temperature between the top boxes and the tubes, that the pressed tube end joints will be loosened and the boxes blown off, starting a violent explosion, perhaps at a pressure equal to or less than the ordinary working pressure.

A blow-off or drain valve should be provided at the hot end of the lower longitudinal header. This valve should be placed in an accessible position, and piped so that it may be used daily when the apparatus is in operation, for the removal of sludge and scale matter while still soft and easily blown out, as well as for draining the economizer whenever it becomes necessary to open it for inspection or cleaning. As in the operation of boilers, much

of the matter which if allowed to remain will eventually form a hard scale, difficult of removal as well as detrimental to the transfer of heat, may be blown out while still soft if the blowoff is operated frequently. A vent pipe of ample size, the end of which is opened to the air should be led from the highest point of an economizer in as direct a manner as possible to some place in the boiler room where it is easily visible. It should be provided with a valve at the open end. This vent will permit the entrance of air when draining the economizer, and its expulsion on refilling. Moreover, if a practice is made of opening this vent as soon as the pressure on the economizer has fallen to nothing, after cutting out of service, and if it is left open until it is desired to start the feed pump through the economizer again, a full economizer will have a relief to the atmosphere which it could only get otherwise by the generation of an internal pressure great enough to cause the safety valve to lift. With this in view, it should be made an absolutely inflexible rule that the economizer should never be left out of service, whether full or empty, unless this vent is opened as soon as the pressure has fallen to zero, and is left so until the vessel is wanted again.

The most important attachment for any pressure vessel is its safety valve, and this is especially true of economizers. We believe that in all large economizers, say of more than 3,000 square feet of heating surface, there should be *two* safety valves, one at either end. The valve at the inlet end may be a water relief valve, but at the outlet end a steam safety valve is preferable. These valves should be of the spring-loaded type, with lifting gear attached, as it is important that they be tested from time to time to make sure that they are not choked or set fast by scale. If in addition they are provided with a good secure "lock-up" attachment, so that their setting may not be tampered with, we feel that an additional safeguard is provided. These valves must be set to operate at a pressure slightly above that at which the boiler safety valves lift, because a slight excess over the boiler pressure must be carried on the economizer and feed line to overcome the friction offered by them to the water flow. This excess need not be over 10 or 15 pounds. That is, if the boiler safety valve is set at 150 pounds per square inch, the valves on the economizer should lift at 160 to 165 pounds. Difficulty has been experienced in keeping this excess within such narrow limits, and for this reason. It is a well-known fact that a relief valve on a hot-water line is a trouble maker, because it is so prone to leak. It is a common experience for some boiler-room employee to set down on the adjusting spring when a leak occurs, and to repeat this treatment from time to time in a vain attempt to cure it. His object is of course to save the hot water, and so lighten his labor at the fires. Such treatment is well known to be futile, but as the grinding in of an economizer safety valve is an unpleasant dirty job, which requires the shutting down of the vessel, it is only too frequently practiced. It requires but a moment's consideration of the causes for leaks in a safety valve to show the uselessness of attempting to correct them by an increase of the spring tension. A safety valve seat consists of one or more conical or flat surfaces, to which corresponding surfaces in the disk have been fitted by grinding. The tightness of the valve depends on the perfection of this contact, that is upon the accuracy with which the disk meets the seat throughout the entire bearing area. The purpose of the valve spring is to put

a load on the valve disk equal and opposite to the load it will receive when acted on by the maximum internal pressure which the vessel is to carry. The spring load affects the tightness of the valve to only this extent, that it permits the seat and disk to remain in contact at pressures lower than this maximum. When a valve begins to leak, it does so from one of two simple causes; either there is a bit of foreign material lodged between the disk and seat, preventing closing, or else one or both surfaces have been injured by cutting. This results from water or steam passing through the orifice at high velocity, perhaps aided by some abrasive material, and is similar to the action of a sand blast. The presence of an abrasive substance is not necessary in the case of a valve opening to relieve the pressure within a vessel containing very hot water, because hot water will immediately turn to steam when its pressure is lowered to that of the atmosphere, if its temperature is above 212° F. The jet of fluid then, which we should expect to find flowing from the relief valve of an economizer, would be a jet of very wet steam, at least at the valve seat, before it has a chance to condense on the surfaces of the relatively cool escape pipe. We need go no further than the experience gained in the operation of steam turbines, for a proof of the fact that a stream of very wet steam, flowing at a high velocity will cut the surfaces of the blades and passages at a rapid rate. In the light of this reasoning, let us consider for a moment what takes place when some one attempts the monkey wrench cure for a leaking safety valve. If the leak has been caused by the pressure of some foreign substance, it will be either embedded in the seat, or crushed, depending on its hardness, and the only result to be expected from an increased spring tension, is that permanent damage may be done where none existed before. If the leak has resulted from cutting, the hole will remain, regardless of the spring tension, unless sufficient pressure can be brought to bear to squeeze the seat and disk into contact again, a process that could scarcely fail to ruin the valve, even if it were possible with the average valve spring. The proper treatment in the first instance, would have been, to lift the valve, allowing it to relieve freely for a short time, which would have washed the seating clean in all probability, allowing the valve to close properly. If the seat has been injured by embedding some foreign particles or by cutting, the only way to make it tight again is to re-grind it until it makes contact over the whole seating area. An overloaded spring, then, can have but one effect, that is to increase the possibilities of damage to property and of personal injury by permitting an over-pressure which is directly determined by the extent of the overloading.

The escape pipes of economizer safety valves, also need scrutiny. As in boiler practice, we feel that a safety valve is best installed when it need have no escape pipe at all. Nevertheless, since it is very important that water should not enter an economizer casing and produce external corrosion, some type of escape pipe is necessary for most economizer reliefs. It is essential that the escape pipe be the full size of the valve outlet. It should be as short and straight as possible, and it may well be installed so that the flow of water from it will be definitely *in the way.* This is the surest means of calling attention to a leaking valve, and in addition serves to impress on the minds of the attendants the fact that the relief valves operate. It is an undesirable practice, indeed it may be very dangerous, to pipe the escape

pipe outlet to a sump, tank, or hot well, where the flow if any passes unnoticed. A tight valve is the safest way to save hot water.

The flues leading to and from an economizer casing should be provided with some form of tight-fitting shut-off damper. These dampers should be separate from the regulating dampers, and should not be used for draft control, either by an automatic regulator, or by hand adjustment. They should be of such a type that they will work easily and when closed they must be tight. It is quite important that the form of damper installed be such that it will retain both its ease of working and its tightness after long-continued service, so that it may be depended upon in an emergency. Whenever the shut-off dampers are closed the soot-pit doors should be opened immediately to prevent pocketing an explosive gas mixture in the casing.

Certain general principles may be applied to the care and operation of an economizer which will make for its safety and long life. The casing and external surfaces must be kept dry if external corrosion is to be avoided. Moisture may get to the outside surface of the tubes and headers in three ways: by leakage from within through tube ends or cracked and pin-holed tubes; by leakage from above of caps, pipe joints, safety valves, or even roofs; or by the sweating of the vessel when water is introduced at too low a temperature. To avoid sweating, some form of heater which will deliver water to the economizer at a temperature above 100° F. is required. In the absence of such a heater, it is possible to send back through a by-pass connection, a small amount of water from the hot end of the economizer, allowing it to mix with the cold water in the inlet pipe, and so regulate the inlet temperature to a point above 100°. When moisture does get at the external surfaces, the resultant corrosion is serious, for both soot and flue gas give rise to corrosive acid solutions when mixed with or dissolved in water.

When an average boiler water is heated in an economizer, it deposits a muddy sludge composed of the various scale-forming impurities contained in the water. Some of the sludge may bake on to the tubes and form a scale. It is not uncommon to find the tubes in an economizer which has been running for some time, coated with over an inch of soft sludge and scale. Under this material, the tubes may appear at first to be sound and of full thickness. A closer examination however, will generally show that the iron has undergone a change. It will be found spongy and soft, easily cut with a knife or scraper, and this condition may extend from a few 64ths of an inch to half the thickness of the tube or more. This decomposed iron, when freshly cut, has about the appearance and consistancy of the graphite "lead" in a lead pencil, and is, of course, the well-known spongy material to be found in most cases of cast iron corrosion. It is a slow process as compared to the corrosion of steel or wrought iron under similar conditions, and as we have said above, only cast iron can satisfactorily resist the corrosive action in an economizer, at least among the materials which are mechanically or commercially adapted to the service. When the interior surfaces of the economizer become coated over with corroded iron overlaid with sludge the action is greatly retarded, if not stopped. On the other hand this sludge layer retards the flow of heat into the water and so cuts down the efficiency of the vessel. A practice has prevailed among engineers of cleaning the tubes with the same sort of turbine-boring tools that are used for the tubes of water tube boilers.

If the boring process could be carried out without disturbing the layer of spongy, corroded iron, no harm would result, and the increased efficiency would warrant the treatment, but unfortunately this corroded layer is very easily detached and wherever it becomes loosened so that the water may penetrate to the freshly exposed surface of sound iron, active corrosion in the form of pitting will be found.

We feel that except in extreme cases, and where great care is taken with the work, this form of tube cleaner is not to be encouraged. It seems better to use some form of scraper similar to the scrapers used for soot removal in the tubes of fire tube boilers. We know of many plants where they are used with success, and a very satisfactory degree of heat efficiency may be retained in the apparatus, without any marked increase in the rate of corrosion. Of course, it is obvious that frequent internal washings with a hose will remove a large part of the soft material before scraping or boring are needed.

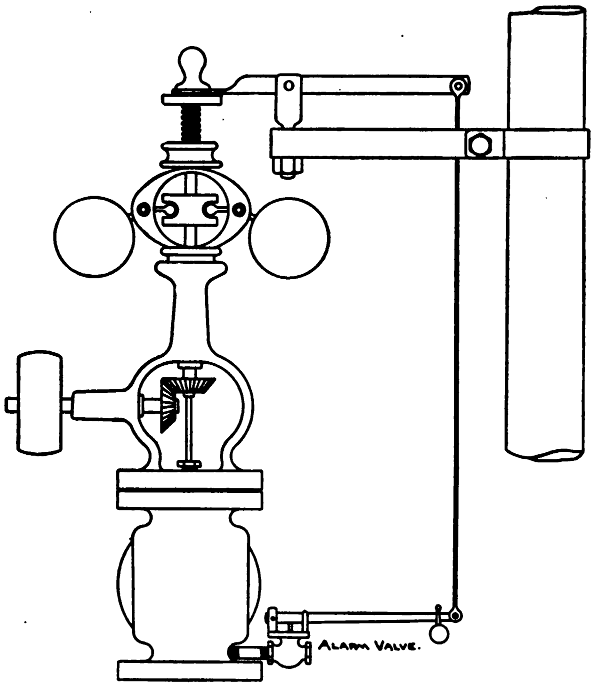
In conclusion, we desire to call attention to the fact that nearly every economizer explosion which has been brought to our notice has taken place in a vessel which was supposed to be out of service, and therefore was due to some abnormal condition, or set of conditions. The lesson to be learned from this fact would seem to be this, that it is of the utmost importance that economizer owners assure themselves that their vessels are provided with the right safety appliances, in good working order, and that the men in direct charge of the vessels be so thoroughly instructed in their work, and held so responsble for the details of manipulation, especially in cutting out of service, replacing in service again and making repairs, that these abnormal conditions will be made just as nearly impossible as the human factor will permit.

Safety Alarm Attachment for Throttle Valve Governors.

THOMAS DOWD, Inspector.

A type of throttle valve governor is in use which while not equipped with an automatic safety stop in the strict sense of the word will nevertheless stop the engine if the belt breaks or runs off provided the engineer has not forgotten to set it in the "safe" position after starting his engine. With governors of this type before the engine can be started it is necessary for the engineer to screw down the small knurled nut which is at the extreme top of the governor. This operation lifts the throttle valve from its seat and holds it in this position, admitting steam to the engine. When the engine has attained its normal speed the nut should be screwed back again. The governor is then at "safety" and will operate to stop the engine if the belt breaks or runs off. Should the engineer forget this and the governor belt break while the nut is screwed down the engine would run away, which would probably result in a wrecked fly-wheel, with consequent damage to the building and its contents.

When inspecting engines equipped with governors of this type a small safety or alarm valve has been recommended to be attached to the throttle valve chamber at a point below the valve seat. From the lever of the alarm valve a connection is made to a second lever which is provided with a forked end to hook under the knurled nut on the governor as is shown in the accompanying sketch.



SKETCH OF THE ALARM VALVE AND GOVERNOR.

This little device has given satisfaction wherever it has been installed as directed. It prevents the engineer from forgetting to set the governor in its safe position while his engine is running, for when he screws down the nut on top of the governor it opens the alarm valve from which steam continues to flow until the nut is set back again to the safe position.

An Unusual Explosion.

C. R. SUMMERS, Inspector.

We have had boiler explosions ever since the steam boiler was invented. Sometimes steam pipes explode or blow-off pipes rupture and even gases explode in the furnace or combustion chamber, as many a singed fireman can attest, but we would never have suspected an ash pit of having concealed within it the ability to blow up and do things to the plant.

Two 60 in x 16 ft. horizontal tubular boilers were recently set up in the basement of an office building. The settings were up-to-date in every particular and unusual care was taken to get a perfect installation. Only one boiler is used at a time, so on a certain day boiler No. 2 was fired up and took the load off the

old boilers, which are to be abandoned. All went well until about four o'clock in the afternoon, when a terrific upheaval took place, all doors about the boiler setting were blown open and fire scattered all over the boiler room floor.

No time was lost investigating, but No. 1 was immediately gotten under way and about four o'clock the next morning, just to show that No. 2 had nothing on No. 1, another upheaval took place, though not nearly so violent as that of No. 2, and No. 1 was continued in service.

No. 2 had cooled down sufficiently by this time so that an investigation could be made and it was found that the concrete bottom of the ash pit had blown up, the grates being lifted off the bearing bars and piled up indiscriminately in the bottom of the furnace. Following this clue it was found that seepage from the outside had found its way under the concrete floor of the ashpit, which was about six inches thick, and since no water was intentionally put in under the grates, in the course of ten or twelve hours the concrete bottom had become hot enough to generate steam under it, with the result that when sufficient pressure had accumulated the bottom came up with remarkable force.

The same thing occurred with No. 1 in about twelve hours after it was fired up, only the concrete was not blown out to such a depth, only about an inch, and the fire was not seriously disturbed.

Who can tell that the insurance companies will not soon be requiring safety valves on our ash pits?

The Explosion of an Oxygen Tank, in Nürnberg, Germany.

Translated from the German by H. J. VANDER EB.*

An oxygen tank exploded last September in a boiler and machine shop in Nürnberg, Germany, where autogenous welding was used for repairing tanks, and to some extent on boilers. The oxygen was manufactured in the shop itself by means of an electric current, and stored in the upper drum of a cylindrical boiler in which the openings to the lower drum were closed by riveted patches. The boiler was buried so that only the upper drum to which the oxygen connections were fitted was above ground.

The explosion took place while welding was in progress, with appalling results. Six persons were injured, three of them seriously, while parts of the shell were thrown 200 feet.

The cause of the accident is attributed (by the Bayerischen Revision-Verein) to the following: Some weeks previous to the accident the commutator of the dynamo which furnished the current for generating the oxygen had been trued up. To do this the wiring connections were taken down. When the job was done, the connections were replaced incorrectly by some mistake, causing a reversal of polarity in the dynamo, so that the electrode which had previously given off oxygen, was generating hydrogen. This hydrogen then mixed with the oxygen still in the tank and formed an explosive mixture. It is further assumed that the flame of the welding torch, striking back through an imperfectly filled water seal, ignited the explosive gas within the tank. It appears, therefore, that even in a case of this kind, a part, at least, of the trouble can be blamed to the proverbial "low water."

Zeitschrift des Bayerischen Revisions-Vereins.

Concerning Stay Bolts Which are not Square With the Sheets They Support.

In submerged tube boilers, locomotive type fire-boxes, and in general wherever stay bolts are used to tie two sheets together whose surfaces are not parallel, it frequently becomes necessary to drill the stay bolt holes out of square with one or both sheets. If this lack of squareness exceeds a certain amount, then threads which start on one side of the hole leave the plate incomplete as is shown in Fig. 1. The difficulty with this sort of work is not so

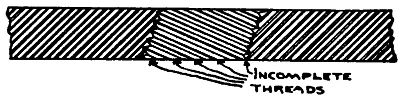


FIG. 1. INCOMPLETE THREADS.

much that it lacks strength as its tendency to leak. The interrupted threads cannot be made steam tight and so, unless several perfect threads can be secured, a permanent leak in the boiler results. With this in view we have worked out for several sizes of stay bolts, made with "V" threads twelve to the inch, the least angle that a stay bolt may make with a plate of given thickness and secure either two, three or four perfect and complete threads.

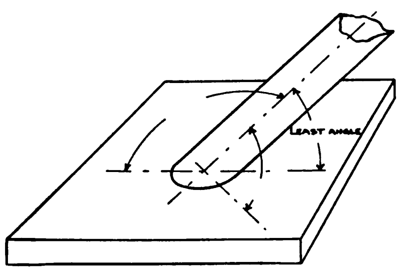


FIG. 2. ILLUSTRATING THE LEAST ANGLE BETWEEN THE BOLT AND THE SHEET.

The tables are nearly self explanatory, but perhaps a word is required to make clear what we had in mind as the "least angle." It is clear that if a stay bolt pierces a plate at any angle other than 90°, there is one least angle between it and the plate, while on the opposite side of the bolt from this least angle is a greatest angle. At any intermediate point the angularity of the bolt to the plate is somewhere between these limits, as is shown in Fig. 2. In every case the least angle has been used in making up the tables. In finished work, if it were accessible, this least angle would be the smallest angle that could be taken off with a carpenter's "bevel" held so as to touch both the bolt and the sheet fairly.

TABLES OF THE LEAST ANGLE A STAY BOLT MAY MAKE WITH A PLATE TO SECURE A GIVEN NUMBER OF FULL THREADS.—V THREADS—12 PER INCH.

TABLE I. *4 Full Threads.*

Thickness of plate.	Diameter of Stay Bolt.							
	½"	⅝"	¾"	⅞"	1"	1⅛"	1¼"	1⅜"
¼ inch	....	....	....	....	....	....	....	......
5/16 "	....	....	....	....	....	....	....	......
⅜ "	....	....	90°*	....	....	....	....	......
7/16 "	90°	89°	88.5°	89.5°	89°	87°	90°	90°
½ "	83°	84°	83°	84°	84°	85°	85°	87°
9/16 "	76°	78°	78°	81°	84°	83°	83°	85°
⅝ "	54°	68°	71°	75°	77°	79°	80°	82°
¾ "	....	48°	56°	64°	68°	71°	73°	77°
⅞ "	....	....	28°	51°	60°	64°	67°	72°
1 "	....	....	....	30°	48°	61°	60°	64°

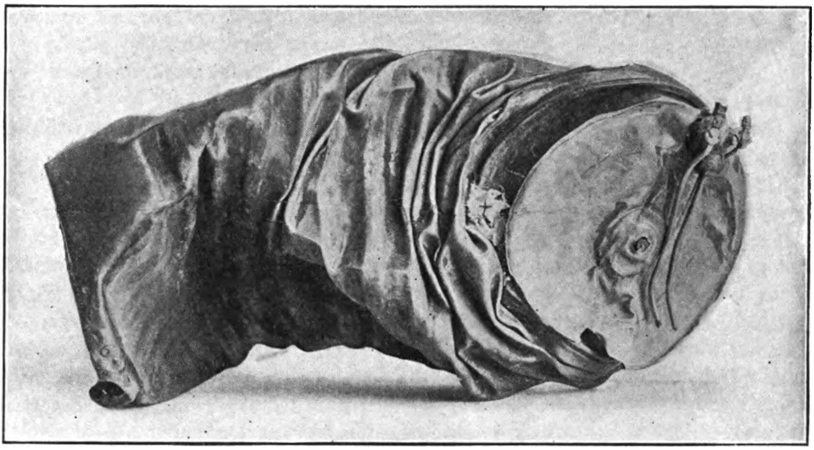
TABLE II. *3 Full Threads.*

Thickness of plate.	Diameter of Stay Bolt.							
	½"	⅝"	¾"	⅞"	1"	1⅛"	1¼"	1⅜"
¼ inch	....	....	....	....	....	....	....	......
5/16 "	....	90°*	90°	....	....	90°	90°*	......
⅜ "	87°	85°	85°	88°	88°	86°	89°	90°
7/16 "	80°	80°	82°	84°	85°	83°	85°	88°
½ "	70°	72°	75°	79°	80°	80°	83°	85°
9/16 "	62°	66°	71°	75°	78°	78°	80°	82°
⅝ "	....	55°	63°	69°	71°	71°	77°	78°
¾ "	....	....	46°	59°	64°	65°	70°	73°
⅞ "	....	....	....	43°	55°	58°	65°	68°
1 "	....	....	....	....	42°	48°	57°	61°

TABLE III. *2 Full Threads.*

Thickness of plate.	Diameter of Stay Bolts.							
	½"	⅝"	¾"	⅞"	1"	1⅛"	1¼"	1⅜"
¼ inch	....	....	90°*	90°	90°*	90°	90°	......
5/16 "	85°	85°	86°	86°	87°	85°	87°	88°
⅜ "	78°	78°	81°	81°	84°	82°	84°	87°
7/16 "	69°	73°	75°	78°	80°	79°	82°	83°
½ "	57°	65°	69°	72°	74°	75°	78°	81°
9/16 "	48°	60°	64°	68°	72°	73°	75°	77°
⅝ "	....	44°	55°	60°	66°	67°	73°	76°
¾ "	....	....	36°	50°	57°	61°	67°	69°
⅞ "	....	....	....	35°	48°	53°	60°	64°
1 "	....	....	....	....	35°	44°	52°	57°

An * signifies that the specified number of threads will be scant.



AN EXPLODED PEANUT ROASTING BOILER.

The Explosion of a Peanut Roaster.

Explosion No. 304 in our list for July, 1912, referred to the failure of a peanut roaster in Sigorney, Ia., on July 29 1912. The roaster stood in front of a restaurant on one of the principal streets of the town. Just before the explosion, Chauncey E. Meyers of Washington, Ia., drew up to the curb in an automobile, and entered a store to make some trifling purchase. As he was returning to the machine, he passed in front of the peanut roaster at the instant when it exploded. The boiler hit him, breaking his back and rendering him unconscious, a condition from which he did not revive. The photograph which we print shows the boiler after the explosion, and at "X" is seen a portion of Mr. Meyers' clothing.

Peanut roasters, like many other small steam containers, are not usually classed as dangerous affairs, and yet we recorded in the Oct., 1911, LOCOMOTIVE (page 241) a similar accident, which took place in Newark, O., and which resulted fatally to two people. If a mere peanut roaster possesses enough explosive energy to burst with fatal results, as in the two cases mentioned above, where is the power or heating boiler so insignificant and harmless that its insurance is unwarranted?

Fly-Wheel Explosions, 1912.

To complete the 1912 list.

(32.) — On October 31, a five ton fly-wheel exploded at the plant of H. S. Williams and Co., Wauseon, O. The damage was largely confined to the engine.

(33.) — The fly-wheel on a gasoline engine exploded November 8, on the ranch of John Laird, near Great Falls, Mont. Mr. Laird was instantly killed.

(34.) — A fly-wheel exploded November 20, at the Queen City Tannery, New York city. There was considerable property damage, but no one was injured.

(35.) — On November 28, a fly-wheel burst at the sawmill of Poutt and Foreman, Titusville, Pa. One man was seriously injured.

(36.) — A fly-wheel exploded November 29, at the Crystal Mine, Tilden, Ill. One man was injured.

(37.) — A fly-wheel burst at the plant of S. G. Flagg, Reading, Pa., on November 30. One person was seriously injured.

(38.) — On December 3, the governor belt slipped off on an engine at the plant of the Woodland Clay Company, Watseka, Ill. The engine raced, exploding its fly-wheel.

(39.) — A fly-wheel, and a wooden driven pulley both exploded December 6, at the plant of the William Coleman Co., barrel manufacturers, Jackson, Tenn. The accident was caused by the breaking of the governor belt. One man, Mr. E. P. Wray, was instantly killed.

(40,) — Albert Schultz was seriously injured on December 19, at North Tonawanda, N. Y., by the bursting of the fly-wheel on a gasoline engine used for cutting corn stalks.

(41.) — On December 23, a fly-wheel cracked on a gasoline engine belonging to the Lone Star Amusement Co., Fort Worth, Texas.

(42.) — A fly-wheel burst, December 26, on a five ton coal truck, gasoline driven, in New York city. A bystander was fatally injured.

Fly-Wheel Explosions, 1913.

(1.) — On January 7, a fly-wheel burst at the plant of the Southern Seating and Cabinet Co., Jackson, Tenn.

(2.) — A pulley exploded January 9, at the Peck plant for reclaiming copper from copper slimes, at Anaconda, Mont. W. M. Young was killed.

(3.) — The fly-wheel on a direct connected generator set exploded January 9, at the Clyde Coal Company's mine near Fredericktown, Pa. Martin Williams was killed.

(4.) — On January 17, a fly-wheel flew off at the power house of the Tacoma Railway and Power Co., Tacoma, Wash. Two persons were injured, one of them fatally.

(5.) — A fly-wheel fractured January 30, at the plant of the Hartselle Stave and Harding Co., Hartselle, Ala. One man was injured.

(6.) — On February 3, a fly-wheel exploded at the Gilbon quarries, Lambertville, N. J. One man was seriously injured.

(7.) — Several rim bolts failed February 3 in a fly-wheel at the Arlington Mills, Lawrence, Mass.

(8.) — On February 14, a large fly-wheel burst at the power house of the Charlottesville and Albemarle Ry. Co., Charlottesville, Va. The accident was due to racing of the engine when the governor belt broke, and was made possible by the failure of the governor to operate in its low safety position, through lack of adjustment. The property loss was estimated at $15,000.

(9.) — A fly-wheel exploded February 21, at the plant of the American Metal Wheel and Auto Parts Co., Toledo, O. The wreck was due to a deranged governor, injured through the bursting of a driven pulley on a line shaft.

(10.) — On March 1, a fly-wheel rim fractured at the plant of the Peoples Gas and Electric Co., Mason City, Iowa.

(11.) — The fly-wheel on an oil well engine burst March 4, near Butler, Pa. One man was killed.

(12.) — A fly-wheel burst March 6, at the mill of the West Yellow Pine Co., Olympia, Ga. The cause is given as an inoperative governor.

(13.) — A gas engine fly-wheel burst during a test on March 7, at Oakland, Cal. A machinist, engaged in testing the outfit, was instantly killed.

(14.) — On March 19, the fly-wheel of a variable speed engine driving a paper machine burst at the plant of the New Haven Pulp and Board Co., New Haven, Conn. The engine and paper machine were badly wrecked, the loss totalling about $6,000.

(15.) — During a storm which unroofed the buildings of the National Rolling Mill, at Vincennes, Ind., on March 21, the belts were stripped from two eight foot fly-wheels by the falling debris. The engine when relieved of its load ran away, and exploded both wheels. Two men were seriously injured.

(16.) — A fly-wheel burst April 18 at the Glens Falls, N. Y., plant of the International Paper Co. The wheel is 14 feet in diameter.

(17.) — On April 30, the fly-wheel on a small gasoline engine used for domestic purposes and owned by Joseph Havir, at Plattsmouth, Neb., exploded. Mr. Havir was instantly killed.

(18.) — A gas engine fly-wheel burst May 2, at an oil well on Morrison's Run, near Warren, N. Y. No one was injured.

On Fusible Plugs.

We have many inquiries from time to time concerning fusible plugs. These inquiries run all the way from requests for advice as to methods and materials for filling, to questions as to the best location in some particular type of boiler. The Locomotive has had little or nothing to say on this subject for many years and although we must admit that there is little that is novel to offer at this time, still it is possible that a general review of the subject may be of interest to some of our readers.

Fusible plugs are often misrepresented. Their true function is not to save a boiler in which the water has gotten dangerously low, but to act as a low water alarm, calling the matter to the attention of the boiler attendant, who can then take the necessary steps to save his apparatus.

Fusible plugs are ordinarily made of brass with a hexagonal head at one end to permit of their being screwed in with a wrench, and threaded with a standard tapered pipe thread. They are either inside plugs or outside plugs depending upon whether they are designed to be screwed in from the water or fire side of the sheet or tube they are to protect. A tapered hole is drilled through the center of the plug, from end to end, with the large end toward the water side of the sheet when the plug is in place. The tapered hole is then filled with a fusible metal, which will be crowded tightly into it by the boiler pressure. The operation of the plug when in good condition is about as follows: As long as the inner end of the plug is covered by water, it will remain at a temperature essentially the same as the water, or about at the boiling point corresponding to

the pressure carried. The exact temperature will depend of course upon the cleanliness of the boiler, for there will be a much greater temperature difference between the metal and the water in a badly scaled boiler than in a perfectly clean one. When the water level falls low enough to expose the plug, the steam can no longer take heat away from the metal as fast as it is supplied by the hot gases with the result that the temperature rises and when the melting point of the fusible material is reached it softens and is promptly blown out by the steam pressure. Steam issuing from the orifice will tend to lower the boiler pressure somewhat, and will perhaps effect a slight deadening of the fire if the plug is located so that the jet can blow back into the furnace, but the principal effect as we mentioned above is to warn the boiler attendants that something is wrong in time for remedial measures to be adopted.

It will be seen that for prompt and certain action a fusible plug must be filled with a material whose melting point is but slightly above the temperature of the water in the boiler at its working pressure, allowing leeway enough for a moderate and quite safe rise in temperature of the metal above the water temperature when the boiler is somewhat scaled. Many different alloys are available for such a use, and nearly any desired melting point may be obtained by a proper mixture of metals. These alloys have been very carefully studied by the manufacturers of automatic sprinkler heads for fire protection, so that sprinklers may be had to fuse at almost any temperature which is thought desirable as a protection against incipient fires. There is one important difference however between the action of an alloy in a sprinkler head and in a fusible plug, namely that in the plug the metal is constantly exposed to the chemical action of the flue gases on the one hand, and the scale forming and corroding properties of the boiler water on the other. The result is that almost all metals when used as fusible plug fillers undergo a slow change. On this account most of the fusible alloys soon become worthless in service and reach a state of decomposition where it is practically impossible to melt them at all. This being true, and because a pure metal is much more stable and dependable under such conditions than any alloy, it has become the custom to fill all plugs with pure Banca tin. This metal will remain in serviceable condition longer than any other material whose melting point is at all suitable. It may be depended upon to melt promptly at about 449 degrees F. which corresponds to a pressure of about 365 lbs. gauge. Since tin will melt long before steel will be injured, but will remain solid at temperatures well above those corresponding to any ordinary steam pressure, it will serve in practice as a universal filling material, and it is required by law in many states, as well as by the United States Steamboat inspectors. One must not rest under the impression however that a tin filled plug will undergo no deterioration in service, for we frequently find cases in which the metal has become hard and crystalline with a thick coating of oxide at the ends, and in this condition the melting point may be very high indeed. Because of this fact, it is important that the plug be so placed that it is accessible both from the steam and fire side of the boiler at inspection, so that the boiler inspector or the engineer in charge may frequently observe if the metal is changing. So long as the metal is clean, and seems soft and malleable when struck with a light hammer, no serious trouble need be anticipated.

There is another reason, quite as important as the first why a fusible plug should be placed in an accessible location. It is the inborn tendency of some men

to neglect or actually dispense with any attachment which is hard to replace. We have found fusible plugs with wrought nails driven in to take the place of the metal which had run out rather frequently, and many instances have been brought to our attention in which an ordinary pipe plug was found by the boiler force to be a ready substitute for the more useful trouble maker. A case in point is the location of the plug in a vertical tubular boiler. In all such boilers except the submerged head type, the plug if it is to be of service must be located in a tube. A hand hole is usually placed in the shell opposite the plug which must be screwed into one of the tubes in the outer row. With the tubes commonly used, a very small plug is required, and the boiler must be quite cold and empty to below the hand hole level before a plug can be replaced. We do not wish to reflect upon those laws, in force in many states, which require a plug in this type of boiler, but we do desire to show that its use is at least a debatable question.

As to the location which we would recommend with various types of boilers, we must first state definitely that wherever legal requirements have been adopted bearing on this important question, they should be accurately followed as a failure to do so may involve the boiler owner in serious difficulty. This is especially true in the event of an accident occuring to a boiler which is not equipped in strict compliance with the law. A general rule would be to place the plug at that level below which the water line should never be allowed to fall, even in an emergency, when there is a fire on the grate. Place it in the most accessible location which will satisfy the first requirement, and by accessible we mean easily reached from both the fire and water sides if possible. The third and last requirement is that the plug be as near the furnace as it may, so that it may be heated to the fusing point in the shortest possible time after being uncovered. Perhaps it may be well to illustrate this rule with a few typical plug locations in familiar types of boilers. In internally fired boilers of the Locomotive, Cornish, or Lancashire type, the plug is usually located in the furnace crown at the highest point, and it ordinarily projects through the crown about an inch, so that it will be uncovered before the crown sheet is entirely dry. In Scotch marine boilers of the wet back type, the plug would be located in the top of the combustion chamber, while in the dry back type of Scotch boiler, the plug is placed in the back tube sheet two inches above the top row of tubes. In the horizontal tubular type, the plug is placed in the rear tube sheet or head, two inches above the tube tops. In water tube boilers the plug is placed if possible in the steam drum at the lowest permissible water level, and if possible in the first pass of the gases. An access door in the setting opposite the plug is of great assistance in this case. With those water tube boilers in which vertical or nearly vertical tubes terminate in an upper drum, the fusible plug is usually placed in the lower head of this upper drum. Special cases of course require special treatment, but we believe that by intelligently applying the general rule which we have given, a satisfactory location may be arrived at for nearly every boiler type. One additional caution is necessary in the case of water tube boilers with regard to the level at which the plug should stand. In many of these vessels the tubes terminate in the upper drum, and are secured to it by a rolled or expanded joint. In such cases the fusible plug should be high enough so that the tube ends will still be covered when the plug operates, for if these tube ends are overheated, all the tubes in the boiler may be ruined.

The Locomotive of The Hartford Steam Boiler Inspection and Insurance Co.

C. C. PERRY, EDITOR.

HARTFORD, JULY, 1913.

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THE LOCOMOTIVE OF THE HARTFORD STEAM BOILER I. & I. CO.

The policies of all companies writing steam boiler insurance express in some way a provision which exempts the insurer from liability for loss due to the explosion of a boiler, the safety-valve of which is adjusted to blow at a pressure in excess of that approved for it by the Company and recorded either by the policy or otherwise. This is obviously a necessary condition of such an insurance contract for the setting of the safety-valve normally determines the limit of pressure which the boiler will carry, and a limitation in pressure to that at which the insurer is willing to undertake the risk, is but proper and just. It is generally so recognized and accepted.

But occasionally an incident arises which shows that while the right of the insurer to limit the pressure is admitted, there is a misunderstanding of what influences should determine the value recorded as the limit of that pressure. This misunderstanding arises with boiler owners,— and sometimes, too, with boiler underwriters, who should know better,— because of a failure to identify the recorded pressure as that of the *maximum safety-valve setting,* as distinguished from the pressure which the insuring Company might approve as within the limitations of safety for a particular boiler structure. Usually, it is true, the strength of a boiler, its condition or the character of its construction determines the pressure at which its safety-valve should be set, but this is by no means always the case. Very frequently it is the strength or condition of some other boiler that is the limiting factor. For the pressure in a number of boilers connected together is of course the same in all, and if one of them for any reason is weaker than the others, the pressure on all must be limited to that which that weaker boiler may safely sustain. To limit the pressure, the safety-valve must be adjusted to blow at not higher than that pressure and thus in accordance with the policy provision a pressure, less than the structure of some of the boilers would warrant, is recorded as approved. Other considerations, too, lead to the same result. For instance, a boiler may be strong enough for a pressure of one hundred pounds per square inch but the purposes of its operation

may be best attained at 15 lbs, per sq. inch. Under such a condition the insuring company may feel it advisable that the safety-valve be set for twenty pounds, not because a higher pressure is unsafe, but because if set at a higher pressure the valve would seldom if ever operate under pressure, and it should occasionally be raised by pressure to demonstrate its condition. Under such circumstances it is the twenty pound pressure which the policy should record as approved.

All this, of course, is to show that an assured, under a steam boiler policy, should not feel himself aggrieved that some higher pressure is not recorded in his policy for a boiler which, he is confident may safely carry it, until he has learned the reason for the limitation. It will usually be found that there is a reason, and a sound one, too.

There seems to be still a strongly rooted feeling among engineers and engine owners that shaft-governed engines are free from fly-wheel accidents due to over speed. This notion is no doubt based on the supposition that since the governor is more nearly an integral part of the engine than the belt or gear driven pendulum type, it is unlikly to become deranged. Of course this is true as far as it goes. That is, a shaft governor is simple and positive. It is free from the menace of broken or displaced belts and it will shut down the engine in the event of many of the casualities which may occur to it. But shaft governors do go wrong in ways which permit the engine to race and as we have shown before the imprisoned weights may even cause a fly-wheel to disrupt if a break in the confining springs or linkage allows them to strike a heavy blow upon the inner surface of the wheel rim. Some engine builders have overcome this difficulty by placing the governor in a separate wheel or governor case, as they call it, which is attached to the crank shaft alongside the fly-wheel. This is unquestionably a step forward and yet the wreck illustrated on another page was on just this very type of engine.

The moral of all this is, that *all* engine wheels should have insurance protection. We do not for a moment desire to be construed as discrediting the value or desirability of stops and governors. Provide them by all means, get the best the market affords and keep them in first class order by utilizing to the fullest the expert knowledge available through an insurance company's inspection service. But do not lose sight of the *insurance* value of a fly-wheel policy for just these "impossible cases" and do not think that a special providence. surrounds your particular engine with a sort of mysterious halo of safety.

Joseph R. Ensign was elected a director of the Hartford Steam Boiler Inspection and Insurance Company at a meeting of the board of directors held Friday, June 27, 1913, to fill the place made vacant by the death last December of George Burnham of Philadelphia. Mr. Ensign is a resident of Simsbury, Ct., and is the vice-president of the Ensign-Bickford Company of that place, manufacturers of safety blasting fuses.

Mr. Ensign was graduated from Yale University with the class of 1889 and received the degree of M.A, from that institution in 1891. In addition to his connection with the Ensign-Bickford Co., he is a director of The Arlington Company, Arlington, N. J., The Tariffville Lace Company, Tariffville, Ct., The Standard Fire Insurance Co., Hartford, Ct., and is a trustee of the Hartford Seminary Foundation. He represented the town of Simsbury in the legislative session of 1910-1911.

Boiler Explosions.

JANUARY, 1913 (concluded from the April LOCOMOTIVE).

(29.) — A tube ruptured January 10, in a water tube boiler at the plant of the Inland Steel Co., Indian Harbor, Ind.

(30.) — On January 10, four sections of a cast iron sectional heating boiler ruptured at the plant of the Hunt Spiller Mfg. Corporation, South Boston, Mass.

(31.) — Several tubes failed on a locomotive attached to Bessemer and Lake Erie passenger train No. 21, at East Pittsburg, Pa., on January 10. Two men were slightly injured.

(32.) — A saw mill boiler exploded January 10, near Brinkhaven, O. One man was fatally injured, and several others less seriously injured.

(33.) — A header connecting two boilers burst January 10, at the Atlas Distillery, Peoria, Ill. No great damage was done.

(34.) — A tube ruptured January 11, in a water tube boiler at the plant of the Dixie Portland Cement Co., Richard City, Tenn. One man was injured.

(35.) — On January 11, a tube failed, and four cast iron headers ruptured in a water tube boiler at the plant of the Grasselli Chemical Co., Grasselli, Ind.

(36.) — On January 11, a tube ruptured in a water tube boiler at the plant of the John B. Stetson Co., Philadelphia, Pa.

(37.) — A greenhouse boiler exploded January 11, at the North Side Greenhouse, Minneapolis, Minn. Julius Rieck, the fireman, was pitched from his cot into a cellar, as the result of the accident, but he fortunately escaped with but slight injury.

(38.) — A tube ruptured January 12, in a water tube boiler at the Brand Brewery of the United States Brewing Co., Chicago, Ill. H. Buesing, fireman's helper, was killed.

(39.) — On January 13, a boiler exploded at the plant of the McMillan Lumber Co., Pine Barren, Fla. One man was killed, one injured, and the plant badly wrecked.

(40.) — On January 14, a boiler ruptured at the Buckeye Clay Pot Co.'s plant, Toledo, O.

(41.) — A fuel economizer exploded January 14, with great violence, at the Glenlyon Dye Works, Saylesville, R. I. Two men were killed, seven or eight injured, and property was damaged to the extent of about $26,000.

(42.) — A heating boiler burst in a school at Vidalia, La., on January 14.

(43.) — A heating boiler exploded January 15, in the basement of Joseph Harper's dry goods store, in the Bronx, New York City. One person was slightly injured.

(44.) — A cylinder head was blown from the main engine at the Farrel Foundry and Machine Co.'s plant, Waterbury, Ct., on January 15. Two men were severely scalded and bruised.

(45.) — A boiler exploded January 16, in a saw mill at a lumber camp a few miles from Booneville, Miss. One man was killed, and four others injured.

(46.) — On January 17, a water tube boiler failed at the University of Wooster, Wooster, O.

(47.) — Two boilers exploded January 17, at the north shaft of the Home-Riverside Mine, Leavenworth, Kans.; 150 miners were isolated in the mine for four hours, until spare boilers could be put in operation, and the hoists set working again.

(48.) — A tube ruptured January 18, in a water tube boiler at the plant of the American Water Works and Guarantee Co., Connelsville, Pa. One man was injured.

(49.) — A tube ruptured January 18, in a water tube boiler at the plant of the Miller Lock Co., Philadelphia, Pa.

(50.) — A water back in a range exploded January 18, in the home of Mr. J. A. Gray, Fort Collins, Kans. Mr. Gray was painfully injured by the explosion, which is said to have been due to the freezing of the pipe connections.

(51.) — Two men were killed and several injured, by the explosion, January 20, of a fuel economizer, at the Arragon Mills, Arragon, Ga. The property loss was estimated at $10,000.

(52.) — Two boilers exploded January 20, at the mill of the Howland Pulp and Paper Co., Howland, Me. Two men were killed and three injured, while the property loss was in the neighborhood of $18,000.

(53.) — A tube burst January 21, in a water tube boiler at the silk mill of A. G. Turner, Willimantic, Ct. The boiler was seriously injured through overheating, as the fire could not be hauled after the accident.

(54.) — A tube failed January 23, in a water tube boiler at the Lower Union Mills of the Carnegie Steel Co., Pittsburg, Pa. One man was injured.

(55.) — An air receiver exploded in the Pennsylvania R. R. yards at Youngswood, Pa., on January 24. A cap, blown from the receiver, broke a steam main, with the result that two men were seriously scalded, one of them probably fatally.

(56.) — A boiler exploded January 24, at an oil pumping station, near Bradford, Pa. One man was fatally injured.

(57.) — A tube ruptured January 25, in a water tube boiler at the plant of the American Steel and Wire Co., Waukegan, Ill.

(58.) — On January 28, a tube ruptured in a water tube boiler at the mill of the Lehigh Portland Cement Co., Mitchell, Ind.

(59.) — A boiler exploded January 29, at the Cleveland, O., plant of the Upson Bolt and Nut Co., injuring four men.

(60.) — A tube ruptured January 31, at the plant of the Allen and Wheeler Co., Troy, N. Y. William Lawade, engineer, and H. McAlpine. fireman, were injured.

(61.) — On January 31, a tube ruptured in a water tube boiler at the Glen Allan Oil Mills, Glen Allan, Miss.

FEBRUARY, 1913.

(62.) — On February 1st, a blow-off failed at the saw mill of T. A. Foley, Paris, Ill. C. O. Willison, the assistant engineer, was scalded.

(63.) — A boiler ruptured February 3, at the cotton mill of the Aiken Mfg. Co., Bath, S. C. The damage was confined to the boiler.

(64.) — A boiler ruptured February 4, at the plant of the Albert Hansen Lumber Co., Garden City, La.

(65.) — Twelve sections in a cast-iron heating boiler ruptured February 4, at the Elizabeth School, Worcester, Mass.

(66.) — On February 5, three sections fractured in a cast-iron heating boiler at the Lincoln and Maple Ave. School, District 95, Cook County, at Brookfield, Ill.

(67.) — On February 5, a cast-iron sectional heater failed at the warehouse of the Pittsburgh Plate Glass Co., Boston, Mass.

(68.) — A tube ruptured February 6, in a water tube boiler at the Congress Hotel, Chicago, Ill.

(69.) — On February 6, a blow-off failed at the plant of the Fort Henry Mining Co., Buhl, Minn.

(70.) — A boiler exploded at the saw mill of T. R. Ritchey, near Rusk, Tex., on February 6. Two men were killed and five others injured, while considerable damage was done to the mill property.

(71.) — A tube ruptured February 7, in a water tube boiler at the plant of the Scoville Mfg. Co., Waterbury, Conn. Joseph Paul, fireman. was injured.

(72.) — A tube rupured February 7, in a water tube boiler at the plant of the New Orleans Railway and Light Co., New Orleans, La.

(73.) — On February 8, a section cracked in a cast iron sectional heater at the Central Hotel, H. B. Dougherty, prop., Maysville, Ky.

(74.) — A blow-off pipe failed on February 9, at the plant of the West Virginia Pulp and Paper Co., Williamsburg, Pa. Considerable damage was done to the boiler.

(75.) — A heating boiler exploded February 10, at an apartment house located at 2117 Guilford Ave., Baltimore, Md. The building was badly wrecked both by the explosion, and the fire that followed. No one was injured, though several had rather narrow escapes.

(76.) — A fuel economizer exploded February 10, at the mill of the Jackson Fibre Co., Bemis, Tenn. Two were killed, and five or six others injured. The property loss was estimated at $25,000.

(77.) — On February 11, five cast-iron headers ruptured in a water tube boiler at the plant of the Ehret Magnesia Covering Co., Fort Kennedy, Pa.

(78.) — A boiler ruptured February 12, at the stone mill of W. McMillan and Son, Bedford, Ind.

(79.) — A tube ruptured February 12, in a water tube boiler at the plant of the Columbia Railway Gas and Electric Co., Columbia, S. C.

(80.) — A boiler exploded February 12, at the Star Mills, Eau Claire, Wis. Owing to the fact that the boiler was carrying but a low pressure at the time, the damage was slight.

(81.) — A boiler exploded February 12, at the mill of the Menominee White Cedar Co., Menominee, Mich. The property damage was estimated at $500, but the engineer and watchman were both badly scalded.

(82.) —A boiler ruptured February 13, at Wharf No 2. of the Maine Central R. R. Co., Portland, Me. The damage was confined to the boiler.

(83.) — On February 13, a tube ruptured in a water tube boiler at the plant of the Allegheny County Light Co., 13th St.. Pittsburgh, Pa. Marion Dilacombo and John Farr, ash wheelers, were injured.

(84.) — On February 13, the blow-off pipe attached to the No 5 boiler failed at the Protestant Episcopal Hospital, Philadelphia, Pa.

(85.) — A section in a cast iron sectional heating boiler failed February 12, in the basement of the Trinity Reformed Church, West New York, N. J.

(86.) —A boiler ruptured at the power house of the Edison Works, East Orange, N. J., on February 13.

(87.) — On February 14, the blow-off pipe attached to the No. 4 boiler failed at the Protestant Episcopal Hospital, Philadelphia, Pa. (This accident is distinct from No. 84, which took place to the blow-off of the No. 5 boiler the day before.)

(88.) — On February 14, eight sections of a cast-iron sectional heating boiler failed in the business block of the Snow Association, 105-107 Federal St., Boston, Mass.

(89.) — A boiler ruptured February 15, at the Sargent Coal Co., Newburg, Ind.

(90.) — A tube ruptured February 15, in a water tube boiler at the plant of the Studebaker Corporation, Carriage Works, South Bend, Ind.

(91.) — A boiler exploded with considerable violence on February 15, at the saw mill of C. R. Cummings, Wallisville, Tex. Four men were killed, five others seriously injured, and the property loss was estimated at $10,000.

(92.) — A tube ruptured February 16 in a water tube boiler at the plant of the Crescent City Stock Yard and Slaughter House Co., New Orleans, La.

(93.) — A boiler exploded February 17, at the saw mill of James Nevill & Son, Gaithersville, Ark. The plant was destroyed, but no one was injured, as the accident occurred just after the help had left for the night.

(94.) — On February 17, the boiler of a Delaware and Hudson locomotive exploded in the railroad yards at Mechanicsville, N. Y. Two men were badly injured, and the boiler was projected about 200 feet.

(95.) — A tube ruptured February 17, in a water tube boiler at the power house of the New Orleans Railway and Light Co,, New Orleans, La.

(96.) — On February 19, a boiler ruptured at the plant of the Milwaukee Western Malt Co., Milwaukee, Wis.

(97.) — The crown sheet of a locomotive type boiler collapsed February 19, at the plant of the Bridge Pasteurized Milk Co., Wichita, Kan.

(98.) — A section ruptured February 19, in a cast iron sectional heater at the Cleveland School, Special School District of Camden, Camden, Ark.

(99.) — A boiler exploded February 19 at the plant of the Carnick Junk Co., Oil City, Pa. The boiler, which was an old one, had been undergoing repairs, and was being tested under steam at the time of the accident. One man, Samuel Blythe, was on top of the boilers making repairs to a steam valve (according to press accounts) and was very seriously, and perhaps fatally injured. He was projected about 75 feet, receiving many broken bones, beside severe scalds and burns.

(100.) — On February 19, a heater exploded in the apartment house belonging to Annie Shaffer, Holyoke, Mass. One of the tenants in the building has brought suit for $1,000 for damage resulting from the explosion.

(101.) — An extracting machine exploded February 19 at the Park Woolen Mills, Chattanooga, Tenn. One man was killed and two others injured as a result of the accident, which was said to have been due to an over pressure of steam.

(102.) — On February 21, a boiler ruptured at the plant of the Jupiter Coal Co., Denver, Col.

(103.) — A boiler used for pumping out oil wells exploded February 21, at the wells of the South Penn Oil Company, near Unity, Pa. One man was seriously injured.

(104.) — A tube ruptured February 22 in a water tube boiler at the mill of the Piermont Paper Co., Piermont, N. Y. Steve Pauko and Brome Barfiero, firemen, were injured, while considerable damage was done to the boiler.

(105.) — On February 22, a tube ruptured in a water tube boiler at the blast furnace of the Pickand Mather Co., Toledo, O.

(106.) — On February 24, a boiler ruptured at the Brush Light and Power Co.'s power house, Brush, Col.

(107.) — A boiler ruptured at the mines of the Munro Iron Mining Co., Iron River, Mich., on February 25. The damage was small.

(108.) — On February 25, a tube collapsed in a vertical tubular boiler at the plant of the Pittsburgh Plate Glass Co., Crystal City, Mo. Three men were injured.

(109.) — A boiler, the property of the Henry C. Clark estate, coal dealers, ruptured February 25, at Providence, R. I.

(110.) — A tube ruptured February 28 in a water tube boiler at the plant of the Mahoning and Shenango Ry. and Light Co., Youngstown, O. Mike Murphy, water tender, was injured.

(111.) — A hot water boiler burst February 29, in the workshop of Nathan Somers, hat manufacturer, Philadelphia, Pa. One man was injured, and some damage resulted to the building.

MARCH, 1913.

(112.) — A tube ruptured March 1, in a water tube boiler at the Waukegan, Ill., plant of the American Steel and Wire Co.

(113.) — On March 1, a tube ruptured in a water tube boiler at the plant of the Northern Texas Traction Co., Handley, Texas.

(114.) — A boiler ruptured March 2, at the wood alcohol plant of Riefler and Sons, Honesdale, Pa. S. Kisner, fireman, was injured, and the boiler was considerably damaged.

(115.) — On March 3, a boiler ruptured at the plant of the Western Cartridge Co., Alton, Ill.

(116.) — A tube ruptured March 3, in a water tube boiler at the plant of the Atlantic Ice and Coal Corp., Chattanooga, Tenn. Jesse Thomas, fireman, was injured.

(117.) — A boiler exploded March 3, in the cellar of the store occupied by the Robert Schmitt Co., Nyack, N. Y.

(118.) — A boiler exploded March 3, at the Moore saw mill, Gladewater, Tex. Two men were killed and three others were injured, probably fatally. The mill was badly wrecked.

(119.) — The boiler of a Pennsylvania R. R. locomotive, drawing a special train loaded with troops on the way to the presidential inauguration, exploded March 3, at East Rahway, N. J. The engineer was killed and the fireman so severely injured that his recovery was considered doubtful. The engine was a complete wreck.

(120.) — A cast iron header ruptured March 4, in a water tube boiler at the plant of the Voight Milling Co., Grand Rapids Mich.

(121.) — A boiler exploded March 4, in the plant of the Milwaukee Lithographing Co., Milwaukee, Wis. The damage was estimated at $3,500.

(122.) — Charles Denton, a 14-year-old boy, was severely scalded March 4, at Old Alton, Tex., by the explosion of a toy boiler which he had made. The small boiler is said not to have had any safety valve.

(123.) — A boiler exploded on March 4, in the greenhouse of J. S. Polland, Cedar Rapids, Ia. The damage was largely confined to the boiler and chimney.

(124.) — A blow-off pipe failed March 5, at the Omaha General Hospital, Omaha, Neb.

(125.) — On March 5, a tube ruptured in a water tube boiler at the plant of the Nichols Copper Co., Laurel Hill, L. I., N. Y. Paul Smegel, fireman, was injured.

(126.) — On March 5, a tube failed in a water tube boiler at the Helmbacher Forge and Rolling Mill Plant of the American Car and Foundry Co., St. Louis, Mo. Three men were injured.

(127.) — Ten cast iron headers ruptured March 6, in a water tube boiler at the plant of the El Dorado Light and Water Co., El Dorado, Ark. The boiler was seriously damaged.

(128.) — On March 6, a tube ruptured in a water tube boiler at the Isabella Furnace of the Carnegie Steel Co., Etna Boro, Pa.

(129.) — A boiler exploded March 6, at the plant of the Solvay Process Co., East Syracuse, N. Y. The explosion caused the destruction of a large caustic conveyor, and much damage was done by the caustic liberated.

(130.) — A water front in a kitchen range exploded March 7, at the home of William H. Gallagher, New Britain, Conn. The range was wrecked, and slight damage resulted to the house furnishings.

(131.) — A boiler using the waste heat from a steel furnace exploded March 7, at the Wilkes Rolling Mill, Sharon, Pa. Thirteen men were injured, three of them fatally.

(132.) — A tube ruptured March 8, in a water tube boiler at the plant of The J. S. Brill Co., car builders, Philadelphia, Pa. One man was injured.

(133.) — On March 10, an accident occurred to the boiler of a locomotive at the plant of the Fordyce Lumber Co., Fordyce, Ark.

(134.) — A boiler ruptured March 12 at the plant of the Princess Furnace Co., Glen Wilton, Va.

(135.) — A tube ruptured March 13, in a water tube boiler at the plant of the American Sheet and Tin Plate Co., Cambridge, O.

(136.) — On March 15, a tube ruptured in a water tube boiler at the Colorado Springs Light, Heat and Power Co. plant of the United Gas and Electric Corp., Colorado Springs, Col.

(137.) — A tube ruptured March 16 in a water tube boiler at the plant of the Plainville Mill and Elevator Co., Plainville, Kan.

(138.) — On March 16, a cast iron heating boiler ruptured at the Imperial Hotel, Atlanta, Ga.

(139.) — A cast iron sectional heater failed March 16, in the Price building, Florence, Neb.

(140.) — A blow-off pipe failed March 18, at the Hotel Montrose, operated by the Cedar Rapids Hotel Co., Cedar Rapids, Ia.

(141.) — On March 18, a cast iron sectional heater failed at the apartment house of Samuel Harris. 113-115 Leonard St., New York City.

(142.) — On March 20, a cast iron cross box failed in a water tube boiler at the plant of the Standard Roller Bearing Co., Philadelphia, Pa.

(143.) — The crown sheet of a boiler at the plant of the American Equipment Co., near Lebanon, Pa., failed March 21. One man was painfully burned, and the plant was shut down pending repairs.

(144.) — A boiler used for heating the Christian Church, Normal, Ill., failed March 22. The damage was slight.

(145.) — Two cast iron headers ruptured March 24, in a water tube boiler at the Friedman Mfg. Co. plant of Armour & Co., Union Stock Yards, Chicago, Ill.

(146.) — On March 24 a tube failed in a water tube boiler at the plant of the Ashaway Line and Twine Co., Ashaway, R. I.

(147.) — A boiler ruptured March 24, at the plant of the Worcester Salt Co., Ecorse, Mich. The boiler was badly damaged.

(148.) — A tube ruptured March 25, in a water tube boiler at the plant of the Tonawanda Board and Paper Co., Tonawanda, N. Y.

(149.) — On March 27, two sections of a cast iron heating boiler failed at the Irving School, Salt Lake City, Utah.

(150.) — A blow off failed March 27, at the plant of the Yolande Coal and Coke Co., Yolande, Ala. One man was scalded.

(151.) — A boiler ruptured March 29, at the Vinita Electric Light, Ice and Power Co. plant of the Middle West Utilities Co., Vinita, Okla.

(152.) — A locomotive boiler exploded on the Texas and Pacific R. R., between Fort Worth and Handley, Tex., on March 29. One man was killed and two others were seriously injured.

(153.) — A boiler burst March 31 at the plant of the Dominion Cloak Co., Toronto, Can.

APRIL, 1913.

(154.) — On April 1, a blow-off pipe failed at the laundry of Tiffany Bros., Aberdeen, S. D.

(155.) — The boiler of a Chicago, Milwaukee and St. Paul locomotive exploded April 1, near Franksville, Wis. Three men, the engineer, fireman and a tramp, were injured, the tramp fatally.

(156.) — A tube ruptured April 2, in a water tube boiler at the plant of the Crescent Portland Cement Co., Wampenn, Pa. Three men were injured, but the property damage was small.

(157.) — On April 5, a blow-off pipe failed at the plant of the Spring Perch Co., Bridgeport, Conn.

(158.) — On April 7, a tee in a steam pipe line failed at the plant of the Florsheim Shoe Co., Chicago, Ill. Ben Franklin, fireman, was injured.

(159.) — A tube ruptured April 8, in a water tube boiler at the plant of the Duquesne Light Co., Pittsburgh, Pa. Martin Flaherty, fireman, was injured.

(160.) — Two cast iron headers ruptured April 9, in a water tube boiler at the plant of the Alpha Portland Cement Co., Martins Creek, Pa.

(161.) — An ammonia boiler exploded April 10, at one of the plants of the Moore Ice Works, Pensacola, Fla. Four men were killed and the plant was demolished.

(162.) — A number of tubes failed April 11, in a water tube boiler at the plant of the Crescent City Stock Yards and Slaughter House Co., New Orleans, La.

(163.) — A kitchen boiler burst April 13, in the home of Frank W. Huff, Philadelphia, Pa. The accident is attributed to starting a fire in the range when the water supply to and from the boiler had been shut off. The cook was so badly injured that she was not expected to live.

(164.) — On April 13, a boiler ruptured at the plant of the Lovegren Lumber Co., Cherry Grove Ore.

(165.) — A boiler exploded April 13 on the property of the Barnsdall Oil Co., near Bartelsville, Okla. The boiler was attached to a well drilling outfit, and was completely demolished. One man was painfully, but not seriously injured.

(166.) — A boiler ruptured April 14 at the brewery of C. F. Bach, Sebewaing, Mich.

(167.) — On April 14, a boiler ruptured at the plant of the Indianapolis Abattoir Co., Indianapolis, Ind.

(168.) — A tube ruptured April 15, in a water tube boiler at the power house of the Terre Haute and Eastern Traction Co., Indianapolis, Ind.

(169.) — A blow-off cock failed April 16, at the plant of the Border City Ice and Cold Storage Co., Fort Smith, Ark.

(170.) — On April 17, a blow-off pipe failed at the power house of the Lake Erie and Western Railway Co., Lima, O. One man was scalded.

(171.) — On April 17, two men were trapped and severely scalded by the failure of a steam pipe in a manhole where they were working, at the plant of the New York and Philadelphia Package Co., Paulsboro, N. J.

(172.) — A man was seriously scalded April 17, by the bursting of a steam pipe in the boiler room of the American Ice Co., Philadelphia, Pa.

(173.) — On April 19, a tube failed in a water tube boiler at the Washington Hotel and Improvement Co.'s building, Seattle, Wash.

(174.) — A boiler exploded April 19 which was used for oil well drilling near Venice, Pa. Two young boys were killed, and two men seriously but not fatally injured.

(175.) — A boiler used for irrigation pumping near Selma, Cal., exploded April 19. Frank Rouch, the owner of the outfit, was instantly killed and his son was very seriously injured. The boiler was an old one which had formerly seen service on a traction engine.

(176.) — A steam boiler exploded April 21, on an oil lease at Tuna, Pa. One man was seriously injured.

(177.) — On April 22, a boiler exploded at the Thompson brickyard, Mount Pleasant, Mich. Four persons, one of them a nine-year-old girl, received injuries from which they died, while several others were more or less severely injured. The property damage was considerable.

(178.) — A tube ruptured April 22 in a water tube boiler at the plant of the Charleston Consolidated Railway, Light and Power Co., Charleston, S. C.

(179.) — A boiler exploded April 23, at the saw mill of A. E. Frankford, Columbia, Pa. Mr. Frankford and Henry Stotz were seriously injured, and the property loss was estimated as in the neighborhood of $1,000.

(180.) — A boiler rupured April 26, at the Monroe Mine of the Oliver Iron Mining Co., Hibbing, Mich.

(181.) — On April 28, a tube ruptured in a water tube boiler at the Trenton plant of the American Bridge Co., Trenton, N. J.

(182.) — On April 28. a cast iron sectional heating boiler failed at the Imperial Hotel, Atlanta, Ga.

(183.) — On April 30, a section in cast iron heater No. 1 ruptured at the Sixth Street School, Louisville, Ky.

(184.) — On April 30, a section in No. 2 cast iron heating boiler ruptured at the Sixth Street School, Louisville, Ky. (Two separate accidents on the same day.)

(185.) — A boiler exploded April 30, at the saw mill of George Rowsey, near Danville, Ky. The plant was completely wrecked, and two men were seriously injured.

THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE COMPANY is now issuing to its policy-holders its "Vacation Schedule" for 1913. Like those of previous years, this schedule affords a most convenient form for arranging and recording the holiday period allotted to each of the clerks or other employees of an institution. From it at a glance may be determined how many and what members of the force will be absent on any given date and thus by a little foresight and care the assignment of the same days to those whose simultaneous absence would cause inconvenience may be avoided.

Copies may be obtained by our policy-holders on application to the nearest of the offices listed on the last page of this issue.

The Hartford Steam Boiler Inspection and Insurance Company.

ABSTRACT OF STATEMENT, JANUARY 1, 1913.

Capital Stock, . . . $1,000,000.00.

ASSETS.

Cash on hand and in course of transmission,		$186,187.28
Premiums in course of collection,		285,163.53
Real estate,		90,600.00
Loaned on bond and mortgage,		1,193,285.00
Stocks and bonds, market value,		3,506,178.40
Interest accrued,		75,600.51
Total Assets,		$5,337,014.72

LIABILITIES.

Premium Reserve,		$2,211,732.44
Losses unadjusted,		94,913.83
Commissions and brokerage,		57,032.71
Other liabilities (taxes accrued, etc.),		47,740.86
Capital Stock,	$1,000,000.00	
Surplus over all liabilities,	1,925,594.88	
Surplus as regards Policy-holders,	**$2,925,594.88**	2,925,594.88
Total Liabilities,		$5,337,014.72

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The Locomotive
of
THE HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

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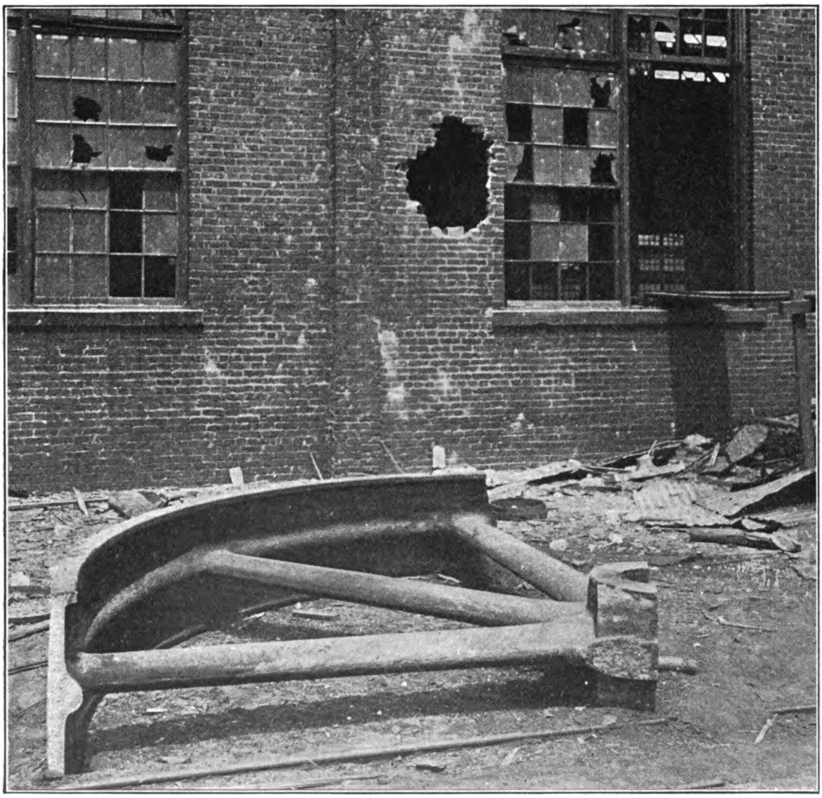

AN UNUSUAL FLY-WHEEL BREAK. BIRMINGHAM, ALABAMA.